2009

Bayou Lacassine Watershed Implementation Plan

Table of Contents

List of Figures

1.0 EXECUTIVE SUMMARY

The State of Louisiana has many water bodies that are not meeting the goals of the Clean Water Act (CWA). The Louisiana Department of Environmental Quality (LDEQ) is responsible for implementing programs to protect and restore water quality within Louisiana. The purpose of the Clean Waters Program (CWP) is to restore the impaired waters so that the public can continue to enjoy their water for fishing and swimming. The Bayou Lacassine is currently not meeting these CWA goals, so LDEQ is working with other partners to restore water quality to the bayou and other bayous in the Mermentau River Basin. needs to be done to improve water quality and restore its designated uses.

The Bayou Lacassine watershed is 398 sq. miles and is in the southwestern portion of the Mermentau River Basin. Bayou Lacassine includes two sub-segments, 050601 and 050603 (Figure 3). Sub-segment 050601 describes Lacassine Bayou from its headwaters to Grand Lake. Sub-segment 050603 describes Bayou Chene-from its headwaters to Lacassine Bayou and also includes Bayou Grand Marais. The most recent water quality data indicates that both sub-segments are fully meeting their contact recreation uses. This means that the water

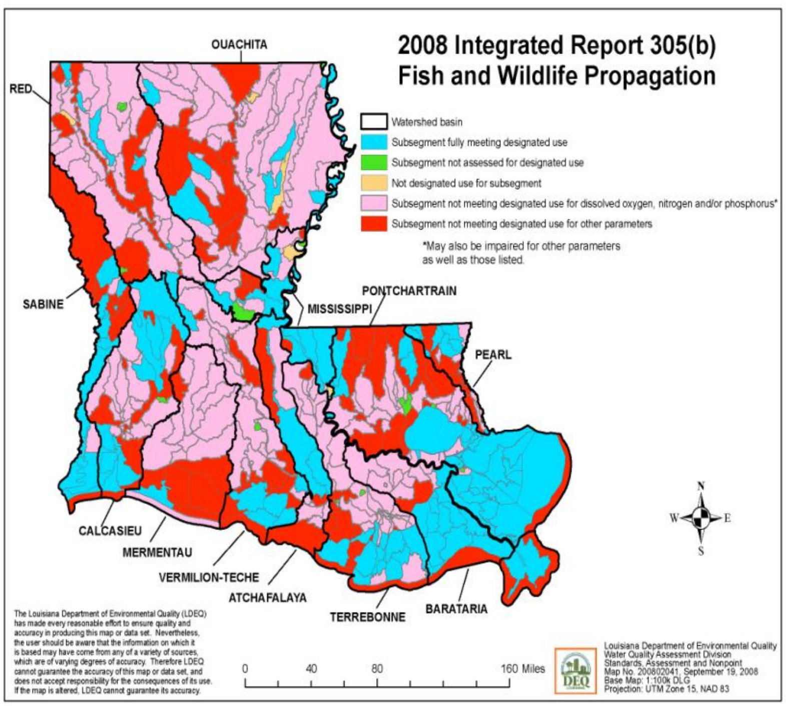

Figure 1

As this map of the state illustrates, many water bodies are listed for not meeting the fish and wildlife propagation uses. The pink watersheds illustrate the areas that have problems with low dissolved oxygen and nutrients. The Bayou Lacassine is one of these water bodies so this watershed plan has been revised to help the local people within the watershed understand what bodies are safe for swimming and boating. However neither of the bayous currently meets the fish and wildlife propagation use. The types of pollution problems that exist in Lacassine Bayou include lead, mercury and low dissolved oxygen. The types of pollution problems that exist in Bayou Chene include fipronil, lead, mercury and low dissolved oxygen. The source of lead is unknown and the source of mercury includes atmospheric deposition and unknown sources. The sources for the low dissolved oxygen include irrigated and non-irrigated crop production, managed pasture and natural conditions. The source of fipronil is also irrigated crop production.

Since the bayous were included on the state's 303(d) list of impaired waters, LDEQ was required to develop total maximum daily loads (TMDLs) for them. The TMDLs set limits on the amount of pollutants that can be discharged into the bayous. This watershed implementation plan is a tool to help the local landowners and residents in these watersheds understand what the TMDLs mean and what types of BMPs and programs they might implement to improve water quality and reduce the amount of nonpoint source pollutants entering the bayous.

The results of the TMDL for Bayou Lacassine indicated that in order to meet water quality standards in Bayou Lacassine upstream of Highway 14, there would need to be an 81% reduction of nonpoint source loading during the summer months and a 41% reduction during the winter months. Downstream of Highway 14, there was no reduction of nonpoint source pollutants required. Along the East Bayou Lacassine, there would need to be a 67% reduction of nonpoint source pollutants during the summer months and a 5% reduction during the winter months. In March 2006, LDEQ did a waste load allocation (WLA) for the Lacassine Mill that was proposed for construction along West Bayou Lacassine. This WLA included permit limits for the mill plus a requirement to reduce nonpoint source loads by 22% during the summer months in order to discharge to West Bayou Lacassine. There was also a requirement to monitor dissolved oxygen in the receiving stream. The TMDL for Bayou Chene indicated that in order to meet the water quality standard for DO, there would need to be a 58% reduction in nonpoint source loading.

These nonpoint source load reductions seem large and will require the involvement of many partners to understand what can be achieved and how water quality standards can be met. The TMDL was calculated during the critical conditions when the temperatures are the hottest and the flows of the bayou are at their lowest. This is one of the reasons that the load reductions are so high. The TMDL does indicate that there is a substantial amount of nonpoint source load stored in the bayous and is still being loaded into the bayous each spring. These pollutant loads will need to be reduced if the Clean Water Act goals are to be met and the water quality restored for Bayou Lacassine and Bayou Chene.

There has already been a lot of work done with BMP implementation on agricultural lands in Bayou Chene and Bayou Lacassine. The Louisiana Department of Agriculture and Forestry (LDAF) is currently working with the local soil and water conservation districts on additional projects to improve water quality there. Through these continued efforts, water quality should be restored and the Clean Water Act goals will

Figure 2: Photo of Bayou Chene

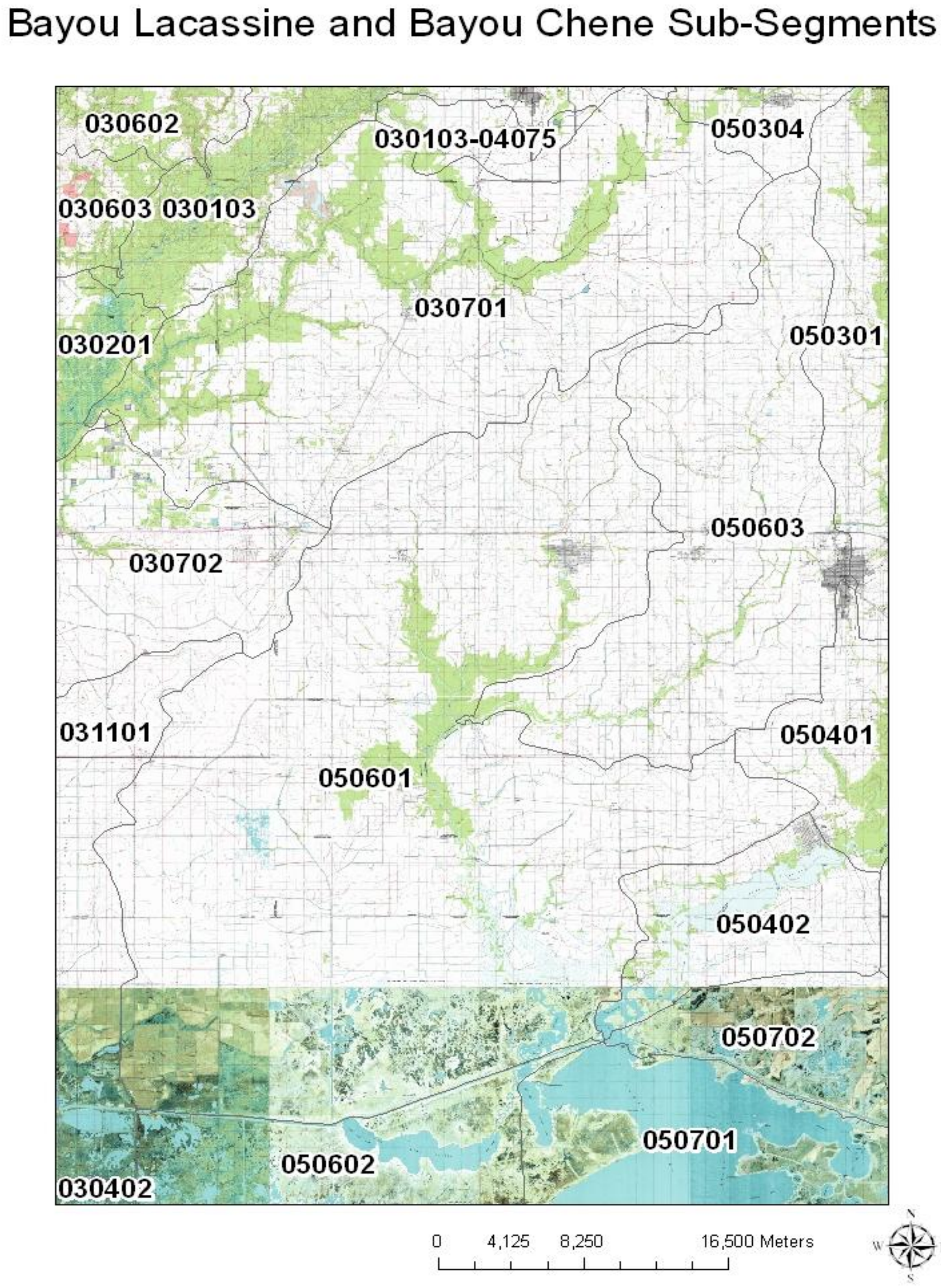
Bayou Lacassine and Bayou Chene Sub-Segments
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Figure 3

USEPA has published a set of guidelines that they expect the states to follow for watershed implementation plans. These guidelines include nine key elements

1.1 USEPA Guidelines for Watershed Implementation Plans

In 2003, USEPA developed a set of guidelines for the states to follow for their watershed plans. These guidelines included nine key elements that USEPA felt were essential for a thorough watershed planning effort. An abbreviation of these nine elements has been included here along with the page numbers as to where these elements have been addressed within this revised watershed plan:

a. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed plan (pages 6-28);
b. An estimate of the load reductions expected for the management measures described in paragraph c below (recognizing the natural variability and the difficulty in precisely predicting the performance of the measures over time) (pages 41-42);
c. A description of the management measures that will need to be implemented to achieve the load reductions estimated in paragraph (b)(pages 40-42; Appendix);
d. An estimate of the amounts of technical and financial assistance needed and/or the sources and authorities that will be relied upon to implement the plan(pages 40-42; Appendix);
e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selection, design and implementation of the NPS management measures (Pages 40-42);
f. A schedule for implementing the NPS management measures that are identified in this plan that are reasonably expeditious(page 43);
g. A description of interim, measurable milestones for determining whether NPS Management measure or other control actions are being implemented(page 43);
h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and if not, criteria for determining if the watershed plans need to be revised(page 39);
i. A monitoring component to evaluate the effectiveness of implementation efforts over time, measured against the criteria established under item (h) above (pages 18-24).

This watershed plan was originally written prior to issuance of these guidelines, but has been revised to address them.

1.2 Partnership

Watershed planning and restoration relies upon many partners who live and work within the area. Some of these partners include the Local Soil and Water Conservation Districts (LSWCD), the Natural Resource Conservation Service (NRCS) and the LSU AgCenter. These organizations have been in the watersheds for many years and understand the types of resource problems that exist and the types of cost-share and technical assistance programs that are available to assist the farmers and landowners in solving the problems. But the most important partner is the landowner, farmer and resident that lives within the watershed. They farm the land, manage pastures and their homes and know the community and the people that live in the watershed. If progress is going to be made in improving water quality, it will always be through the efforts of the local people that live and work in the watershed.

All of the other cooperating agencies and organizations need to support them and their efforts to improve the water quality in their local bayous.

A local watershed coordinator has been hired by LDEQ to work with agencies, landowners and the residents of the Bayou Lacassine Watershed to improve their water quality. The watershed coordinator is housed in the Acadiana Resource Conservation and Development District (R.C. &D) and will be working on several of the local water bodies that are currently not meeting the goals of the Clean Water Act. LDEQ will be working along with them to provide information, educational materials and assistance to help restore the designated uses to the bayous.

The Office of Soil and Water Conservation applies directly for Section 319 funds to implement agricultural practices in watersheds where TMDLs have been completed and watershed plans have been written. These funds are provided through the local soil and water conservation districts.

The USDA has local work groups that provide input on their resource concerns to the Soil and Water Conservation Districts so all of these efforts can work together to help prioritize where the highest priority areas are for BMP implementation.

1.3 Water Quality Data

The Louisiana Department of Environmental Quality (LDEQ) has collected water quality data in Bayou Lacassine (050601) at the highway 14 bridge near Hayes in Jefferson Davis Parish since March 1978. The long-term historical trends indicate a seasonal peak in sediments and nutrients in the spring of the year, typically in April, followed by a decline in the dissolved oxygen concentration (D.O.) during the summer months. This sag in the D.O. concentration prevents the bayou from complying with the water quality standards for dissolved oxygen. The dissolved oxygen concentration relates to the fish and wildlife propagation use and caused the water body to be included on the 1999 court ordered 303(d) list of impaired waters. Once the water body was on the 303(d) list, then it was scheduled for a total maximum daily load (TMDL) which was competed by FTN in 1999 and revised on September 2000.

Figure 4: Photo of Rice Field Drains

Bayou Lacassine was included on the 1999 court ordered 303(d) list for *phosphorus, nitrogen, suspended solids, turbidity, organic enrichment/D.O., lead, oil and grease.* The suspected sources of these pollutants included: *agriculture, non-irrigated and irrigated crop production, urban runoff and storm sewers and unknown sources*. Bayou Chene (050603) was included on the court ordered 303(d) list because of *organic enrichment* and *low dissolved oxygen*. USEPA Region 6 developed a TMDL for dissolved oxygen for Bayou Chene in 2002 and a TMDL for fipronil in the selected sub-segments in the Mermentau River Basin, including Bayou Chene in 2002.

A total maximum daily load (TMDL) is defined as a calculation of the maximum amount of a pollutant that a water body can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. The Clean Water Act (1972) required that states develop TMDLs for any surface water bodies which were impaired, that is, they did not consistently meet water quality standards. A TMDL implementation plan is a plan which describes how to restore water quality to compliance with water quality standards.

Figure 5: Photo of Rice Field

2.0 Description of Watershed

Bayou Lacassine is a 398 square mile watershed in Southwestern Louisiana, in the Mermentau River Basin (see figure 3). The region is sparsely populated, and characterized mainly by agriculture. Table 1.1. estimated the percentages of different land-uses that comprised the watershed when the TMDL was done in 1999 (taken from TMDL-LDEQ, 1999). The two main urban communities are Welsh and Jennings, with estimated populations of 3,407 and 11,879, respectively (USGS 2001). As can be seen in figure 3, the Bayou Lacassine watershed includes the following tributaries: East and West Bayou Lacassine, Bayou Chene, Thornwell Drainage Canal and several unnamed tributaries. The area is sparsely populated outside of these small rural communities. The only two wastewater treatment systems that were included in the modeling effort for the TMDL were Welsh and Jennings.

The main agricultural crops in the watershed are rice, soybeans, pasture and sugarcane. There is a seasonal peak in the concentration of nutrients in the bayous (nitrates and nitrites, total kjeldahl nitrogen, and total phosphorous) that coincides with the spring discharge of muddy water from the rice fields. This association is supported by over two decades of water quality data collected by LDEQ. There is cumulative evidence that a large proportion of the loading in the watershed is exerted in a concentrated region in the upper main stem of Bayou Lacassine, and around the confluence of East and West Bayou Lacassine. This area is dominated by rotational rice/soybean production. Incorporation of Best Management Practices (BMPs), such as precision leveling and dry field planting should eliminate the spring rice discharges and bring the watershed into compliance with the TMDLs for dissolved oxygen. Bayou Lacassine has had exceedences of the pesticides carbofuran and fipronil. Best management practices for the control of fipronil are included in the plan. The use of carbofuran is now strictly limited.

Table 1.1 Land-uses in Segment 0506 (LDEQ, 1999)

Land Use Type	% of Total Area
Urban	0.8
Extractive	0.3
Agricultural	65.7
Forest Land	1.8
Water	2.2
Wetland	29.1
Barren Land	0.0
Total	100

2.1 NPS Sources and Pollution Issues

The 1998 303(d) list (LDEQ, 1998a) cited Bayou Lacassine as being impaired due to organic enrichment/low dissolved oxygen (DO), suspended solids, nutrients, and dissolved lead. The TMDL was developed for organic enrichment/low DO in 1999. Based on more recent data, suspended solids have been removed from the 303(d) list for Bayou Lacassine. The 2008 305(b) report indicated that Bayou Lacassine remained impaired due to organic enrichment/low DO, lead and mercury.

The reduction of dissolved oxygen in the watershed is basically caused by biological oxygen demanding (BOD) substances that reside within the water bodies. Nutrients increase the rate of BOD, and thereby lower dissolved oxygen. Nutrients often move with sediments during rainfall events or rice field discharges, so sediment and nutrient loads contribute to sediment oxygen demand (SOD). Sediment loading can be attributed to agriculture, construction sites, forestry, and residential areas. In the Bayou Lacassine watershed, land-use is 65.7% agriculture, therefore sediment loading from agriculture is a primary concern. Nutrient loading can also occur through agriculture, urban runoff and home sewer systems.

It must be noted that since the Bayou Lacassine is a slow flowing water body in a flat coastal plain, conditions tend to be naturally low in oxygen and are often dystrophic. In the development of the model, the Bayou Nezpique was used for comparison.

2.2 How much Reduction is Required?

The TMDL requires significant reductions in manmade nonpoint source loads, particularly in East Bayou Lacassine, upstream of Highway 14. This reduction is calculated for the 7Q10 condition. This means that in order to meet water quality standards during the lowest consecutive 7-day period of flow in 10 years, there would need to be an 81% reduction in in-stream nonpoint loads. This is a conservative estimate, and should be viewed as such. The TMDL also requires more stringent permit limits for the point source discharges from the waste water treatment plants (WWTP) at Welsh and Lacassine. The upgrade specifies required discharge concentrations of 5mg/l $CBOD_5$, 2mg/l ammonia nitrogen, 1mg/L organic nitrogen, and 5mg/L DO at both facilities.

2.3 What Percent of the Total Discharge is NPS Responsible for?

NPS was estimated to represent 65% of the total pollutant load during the summer months, and 75% of the total pollutant load during the winter months. It is obvious that nonpoint source loading is the pollution problem that prevents the bayou from meeting the water quality standards for dissolved oxygen in the Bayou Lacassine watershed.

2.4 Discussion of How Much of the Load is from each Source

The results indicate that a high proportion of the loading is due to re-suspension of benthic sediments (those sediments stored on the bottom of the bayou). The implication of this includes the probability that historical loading patterns, as well as the current loading modeled by the TMDL are important in understanding the total pollutant load. Detailed discussion of the loading patterns for each stream reach has been included in Section 6.

Figure 6: Photo of Soybean Plants

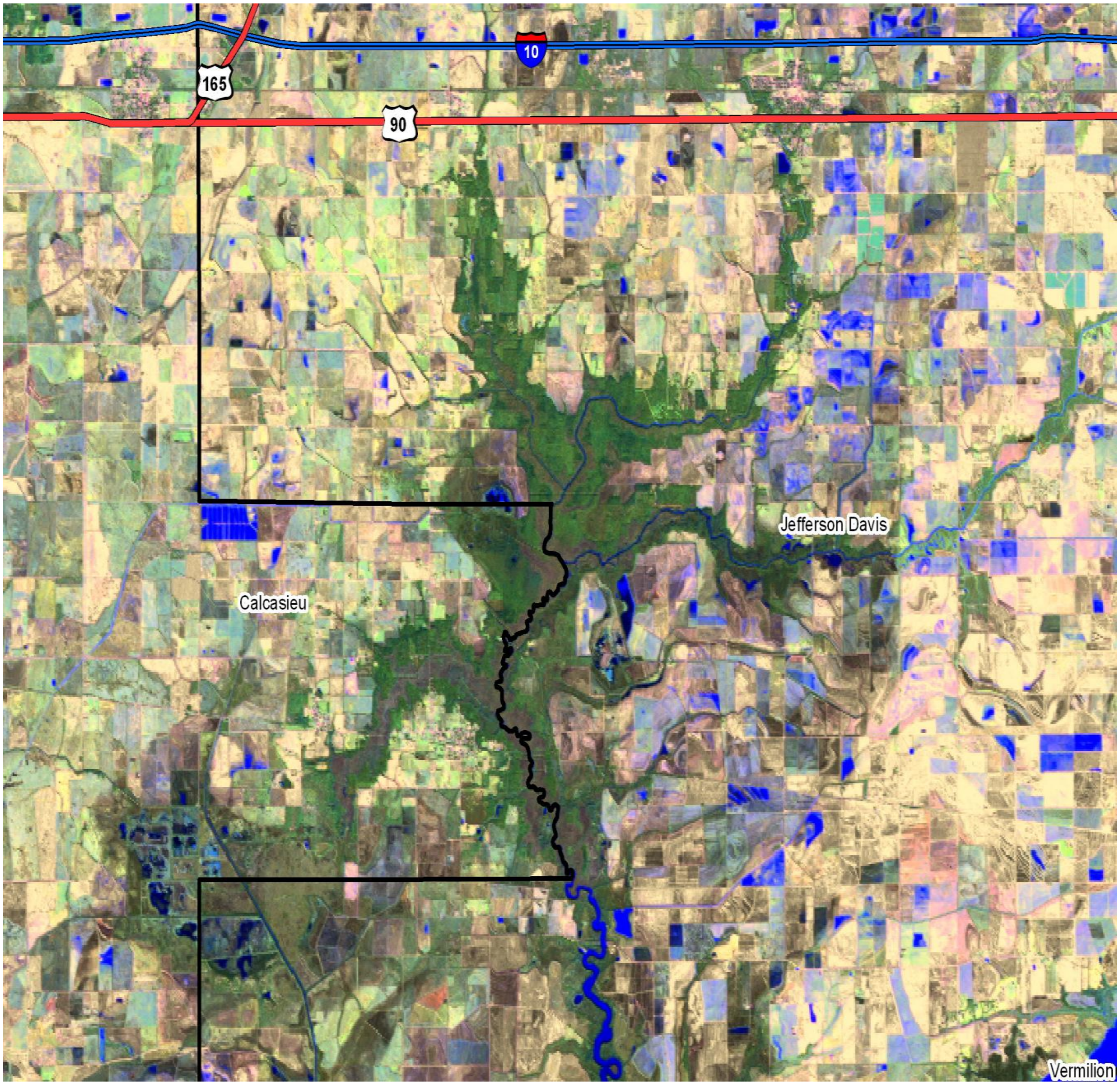


Figure 7: Aerial Image of Bayou Lacassine Watershed

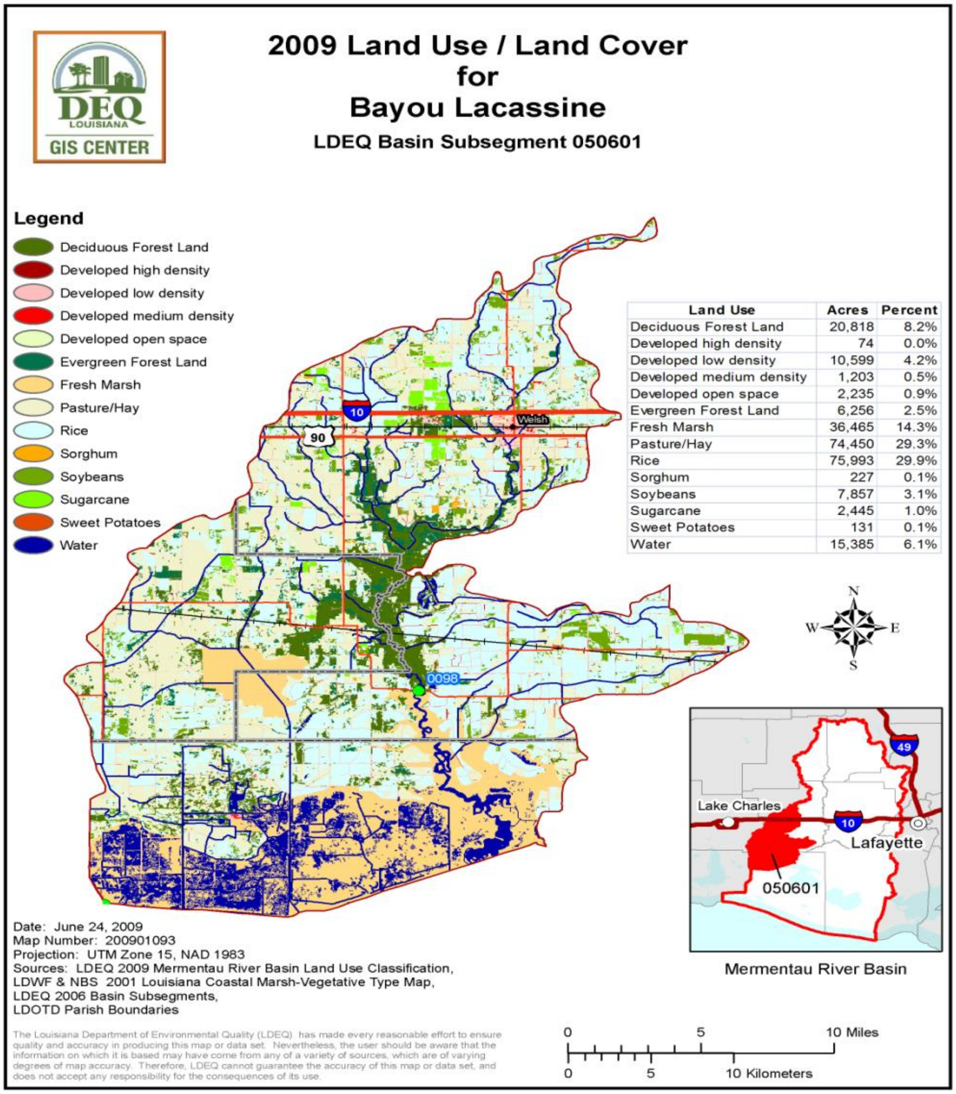


Figure 8

3.0 Land-Use

Understanding the range of land-uses that exist within the watershed is an important aspect of understanding the sources and causes of pollutants and where they originate. Since the major problem that has been identified as contributing to the low dissolved oxygen concentration is the sediment that is stored on the bottom of the bayous, it is important to look at where the sediment may be coming from. Land-use data provides insight into the types of crops that may be contributing to those sediment loads that are stored in the bayou.

3.1 Land-Use Data

During the summer of 2008, the staff at LDEQ gathered field data to produce a land-use map of the Mermentau River Basin. Figure 8 illustrates the results of the map for Bayou Lacassine and Table 1.2 shows the tabular data of land-use that was generated through that field and satellite imagery classification process. The land within the watershed is almost equally divided between rice (29.9%) and pasture/hay (29.3%). Fresh marsh occupies 14.3% or 36,465 acres within the Bayou Lacassine watershed. There are more than 20,000 acres of deciduous forests and 6,000 acres of evergreen forests.

Table 1.2: Land-Use Data for Bayou Lacassine

Land Use	Acres	Percent
Deciduous Forest Land	20,818	8.2%
Developed high density	74	0.0%
Developed low density	10,599	4.2%
Developed medium density	1,203	0.5%
Developed open space	2,235	0.9%
Evergreen Forest Land	6,256	2.5%
Fresh Marsh	36,465	14.3%
Pasture/Hay	74,450	29.3%
Rice	75,993	29.9%
Sorghum	227	0.1%
Soybeans	7,857	3.1%
Sugarcane	2,445	1.0%
Sweet Potatoes	131	0.1%
Water	15,385	6.1%
Total	**254,138**	

If you look at the map carefully, you can see that there is a high density of rice in the headwaters of Bayou Lacassine north of Welsh. There is also a higher density of rice along the lower tributaries that drain into Bayou Lacassine just above LDEQ's water quality monitoring station. These tributaries that feed directly into the bayou and carry sediments, nutrients and organic loads from the rice fields when they are drained in the spring are areas that should probably be targeted for rice best management practices. The map also illustrates that the pasture/hay areas lie more in the western portion of the watershed and should be targeted for pastureland best management practices such as rotational grazing.

The Bayou Chene watershed is approximately 86,000 acres or about 1/3 the size of the Bayou Lacassine watershed. Approximately 51% of the watershed is utilized for rice production and 26% for pasture/hay. There is about 5,000 acres each of low density development and soybeans, each representing a little more than 6% of the watershed. A close examination of the watershed map for Bayou Chene indicates that there is a high density of rice acreage along the tributaries that drain into Bayou Chene both on the north and south side of Interstate 10. The water quality monitoring station is located at the base of the watershed and will capture the effects of the pollutant loads from the rice fields entering the bayou. Rice fields along the tributaries should be targeted for BMP implementation and the pasture/hay

Table 1.3: Land-Use Data for Bayou Chene

Land Use	Acres	Percent
Deciduous Forest Land	5,442	6.3%
Developed high density	148	0.2%
Developed low density	5,573	6.5%
Developed medium density	894	1.0%
Developed open space	995	1.2%
Evergreen Forest Land	899	1.0%
Pasture/Hay	22,364	26.0%
Rice	43,903	51.0%
Sorghum	14	0.0%
Soybeans	5,302	6.2%
Sugarcane	419	0.5%
Sweet Potatoes	153	0.2%
Water	1	0.0%
Total	**86,106**	

acreage should also be prioritized for pastureland best management practices.

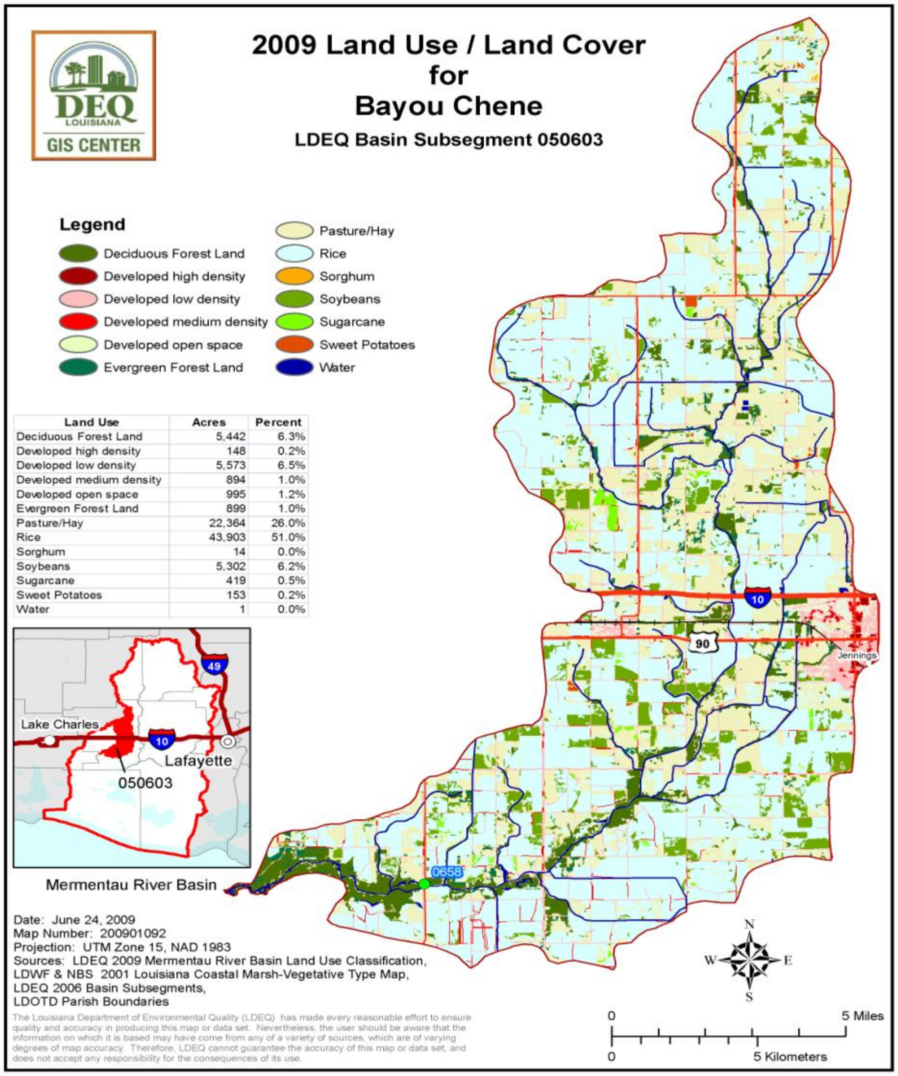


Figure 9

Table 1.4 includes data from the 2008 agricultural summaries that are published by the LSU AgCenter. These data indicated that the dominant form of land-use in Jefferson Davis parish is rice (35%). Crawfish and soybeans occupy a large percentage of the land within the parish and waterfowl is second only to rice in land-use patterns. Sugarcane and wheat are also found in parish, along with cattle and rangeland.

Table 1.4 indicates that the majority of the land in Calcasieu Parish is utilized for hay and waterfowl followed by rice and soybeans. Crawfish ponds and sugarcane fields are also found in Calcasieu parish. There is also a lot of range land and cattle in Calcasieu Parish

Table 1.4 indicates that the majority of the land in Cameron parish is utilized for waterfowl with the remaining land in rice and hay production or for cattle.

Land-use	Jefferson Davis	Calcasieu	Cameron	Totals
Rice	81,500	9,902	10,788	102,190
Soybeans	22,600	5,312		27,912
Sugarcane	4,100	2,227		6,327
Hay	16,000	18,000	2,850	36,850
Waterfowl	80,000	18,000	426,240	524,240
Crawfish	25,000	2,500		27,500
Wheat	2,800			2,800
Total	232,000	73,941	439,878	745,819

Table 1.4 Land-Use Information from 2008 Ag Summary

3.2 Summary of Land-Use Patterns

The aerial photograph in Figure 10, indicates that rice agriculture often occurs very close to the bayou for irrigation purposes, and there may be up to four discharges a year into the bayou from drainage of flooded fields (see Figure 11).

The portion of the watershed which is contained within Jefferson Davis parish includes: the headwaters of Bayou Lacassine, the tributaries of East and West Bayou Lacassine, Bayou Chene, and the east bank of the main Bayou Lacassine down to the border with Cameron Parish (about three miles below highway 14).

4.0 Erodability of Soils

4.1 Importance of Erodability of Soils

It is important to understand that there are a multitude of factors influencing the loading rates of sediment/nutrients into any portion or stream reach of the watershed. Land use is clearly an important consideration, since intensive agriculture may cause high rates of soil erosion and sediment runoff. The inherent soil erodability may also be critical in determining loading rates. It is possible that two different stream reaches with the same land use patterns may have different loading rates, because one area has underlying soils, which are more susceptible to erosion. For this reason, this section of the plan examines the inherent erodability of the different soils in the Bayou Lacassine watershed. Erodability of soils is a function of the inherent properties of the soil (elasticity, etc.) and the slope. The data included within this section was provided by the Natural Resource Conservation Service, or NRCS (2001).

Figure 10: Tributary to Bayou Lacassine

4.2 Soil Types.

As illustrated in figure 13, the majority of the watershed is characterized by various silty loams, including the Crowley-Vidrine loam, and the Mowata silt loam. There does not appear to be a great deal of complexity in the pattern of soil types, and the soils naturally become more silty towards the lower (southern) portion of the watershed.

4.3 Soil Erodability

As illustrated in figure 14, the erodability index for much of the watershed ranges from 3.07-3.53. However a large area of soils with a relatively high erodability index (6.23) exists at the confluence of East and West Bayou Lacassine, and on the north bank of the Bayou Chene. This area includes some of the stream reaches where rice/ soybean agriculture is dominant in Jefferson Davis Parish. In summary, the soils data indicates that the area near the confluence of the headwaters of East and West Bayou Lacassine, and the north bank of Bayou Chene, are zones of relatively high erodability. Soil erodability data is only one factor in the complex puzzle of watershed loading, and should be used only as supporting data. This data does indicate that agriculture in the Jefferson Davis section of the sub-segment may be particularly significant to nonpoint loading in the watershed, pinpointing the specific areas of the confluence of East and West Bayou Lacassine and the north bank of Bayou Chene.

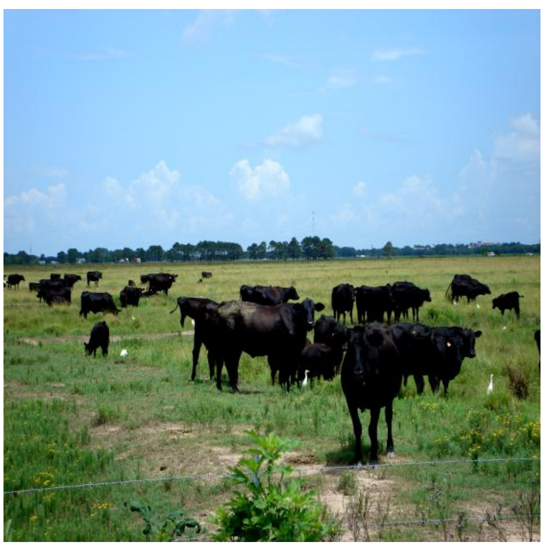


Figure 11: Pasture and Rangeland

Figure 12. East Bayou Lacassine, from the air. Rice agriculture is dominant in this area and occurs close to the bayou.

Figure 13: Rice Fields Discharging within the Bayou Lacassine Watershed

Figure 14: Rice Fields

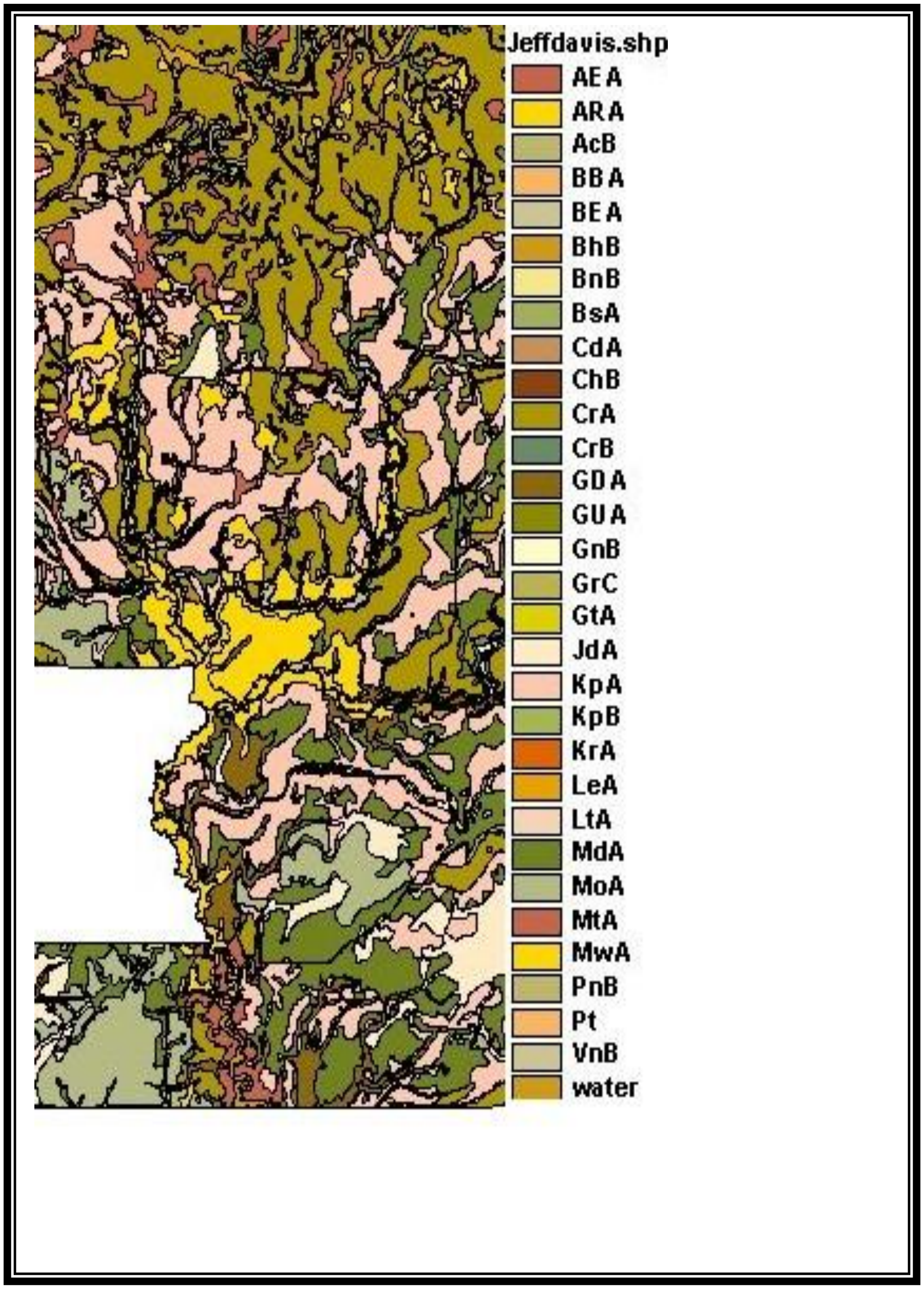


Figure 15: Map of Soil Types for Bayou Lacassine Watershed

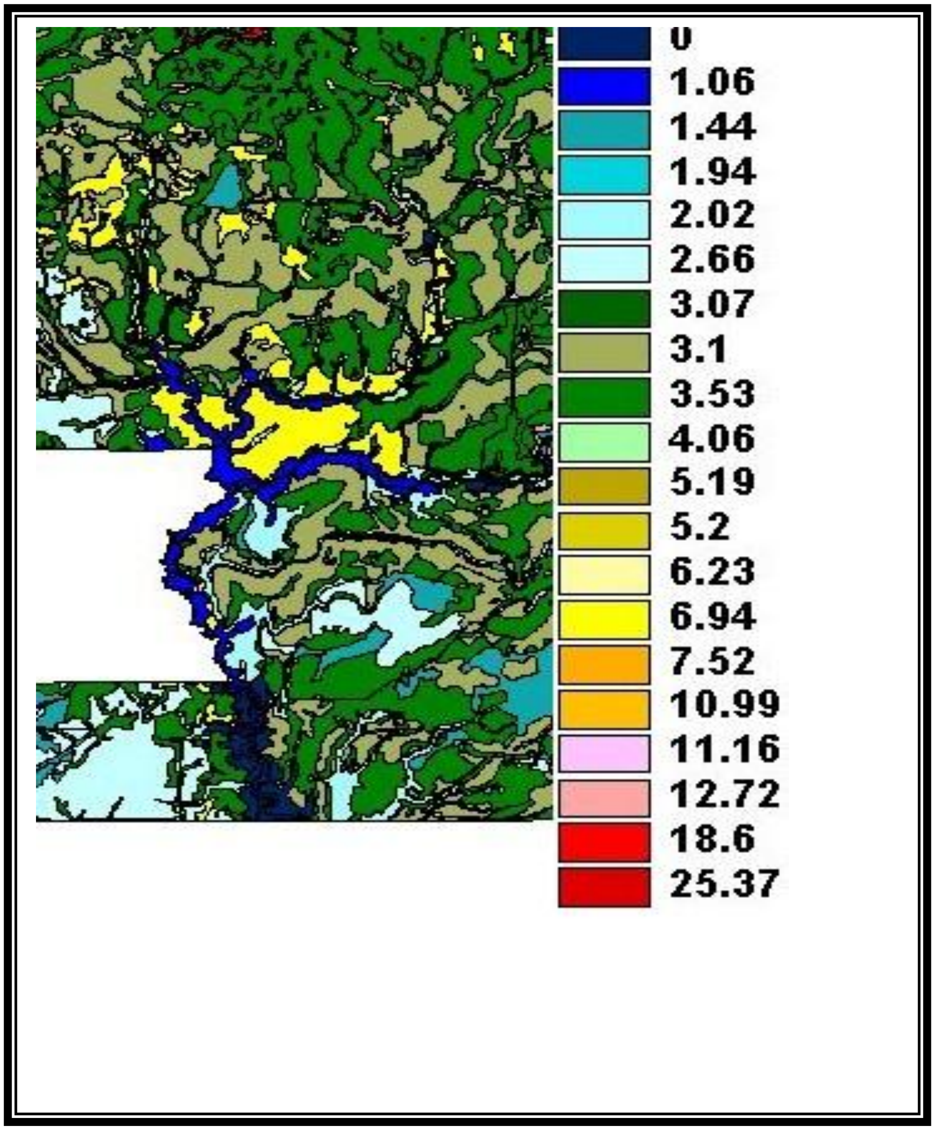


Figure 16: Map of Soil Erodability

5.0 Water Quality Monitoring

5.1 Monitoring

LDEQ has monitored the water quality on a monthly basis, at the crossing of the Highway 14 bridge on Bayou Lacassine from March 1978 – December 1998. This historical data is discussed within this section of the watershed plan. When LDEQ initiated the 5- year cyclic basin monitoring program, Bayou Lacassine was sampled monthly from January to December, 2003, and again in 2008. LDEQ has now changed the sampling cycle to a 4-year cycle so should be back in the Bayou Lacassine watershed again in 2012.

Figure 26 illustrates the pattern of median dissolved oxygen values between 1976 and 2000. The summer median values fell below 3.0 mg/L in seven different years over this 24 year period of record. The water quality standard for dissolved oxygen in Bayou Lacassine is 3.0 mg/L during the summer months. During the winter months, the median values for DO only remained above 5 mg/L nine years over the 24 year period of record. However, the DO only dropped below 4 mg/L in six different years over this same time period during the winter months. This means that over this 24 period of record the median values for dissolved oxygen remained between 2 and 5 mg/L most of the time.

Figure 28 illustrates the characteristic spring peaks of turbidity, total dissolved and total suspended solids that are seen in the Mermentau River Basin. These peaks typically occur in March or April and coincide with rice field discharges. Figure 26 illustrates similar peak in total nitrogen in April. The graph of total organic carbon also illustrates large load entering the bayou from February through June and then peak again between October and December.

The ambient water quality data that LDEQ has collected for Bayou Lacassine in 1998, 2003 and 2007 actually indicates some declining trends in dissolved oxygen and

Figure 17: Bayou Lacassine Along Pasture

increasing trends of turbidity, total suspended solids, nitrogen and phosphorus. The water quality data for Bayou Chene also indicates that the dissolved oxygen has declined since 1998 and 2003. However the spring peaks of turbidity, total kjheldal nitrogen (TKN) and total suspended solids were much higher in 2003 than 2007 in Bayou Chene. The water quality data for both Bayou Chene and Bayou Lacassine indicate similar spring peaks of discharges in April for the turbidity. The Charts on the next few pages illustrate these patterns of water quality trends within these two bayous.

Closer analysis of the water quality data for dissolved oxygen in Bayou Lacassine indicated that the median value of DO during 1998 was 4.4 mg/L with a minimum value of 0.12 and a maximum value of 6.3 mg/L. During 2003, the median value was 4.2 mg/L, the minimum value was 1.32 and the maximum value of 6.21 mg/L. During 2007, the median value dropped to 2.51mg/L and the minimum value dropped to 0.07 mg/L and the maximum value dropped to 5.75 mg/L. There were also more days in 2007 when the dissolved oxygen concentration fell below 1 mg/L which is not a healthy level for fish populations. In 1998, there was only one day in October that the DO concentration fell below 1 mg/L and in 2003, it never fell below 1 mg/L, but in 2007, it fell below 1 mg/L 3 times, once in April which is early in the year for that low of a DO reading. Total suspended solids and total phosphorus, total kjhedahl nitrogen, and turbidity were all high February or April of 2007 so this may be part of the reason for the low DO readings during that month.

Water quality in Bayou Chene drops below 5 mg/L in March and never gets above 1.0 or 1.5 for the rest of the year during 2007. The data was a little better in 1998 and 2003 but between April and October, the water quality standard for D.O. is never really met and the data shows that the concentration stays low during those months. The water quality data for Bayou Chene indicated large peaks of total suspended solids, turbidity and total kjhedahl nitrogen in April of 2003 and smaller peaks during April 2007. After these spring peaks, the concentration of solids and nutrients trails off but the dissolved oxygen concentration remains low through October. Therefore in order to improve water quality, the spring peaks of sediments and nutrients will need to be reduced through implementation of BMPs on agriculture land.

Several of the graphs of the historical data have been included to illustrate the long-term trends of spring peaks of turbidity, total suspended solids and nutrients and the sag in dissolved oxygen that occurs in the bayou each spring and summer.

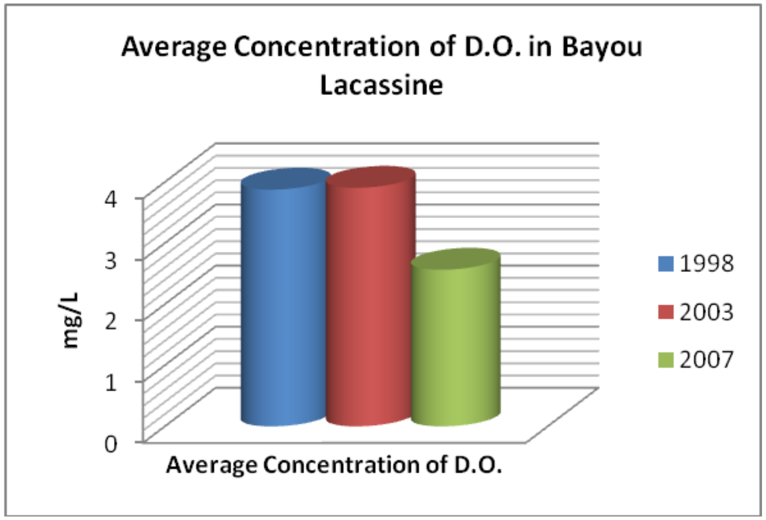


Figure 18

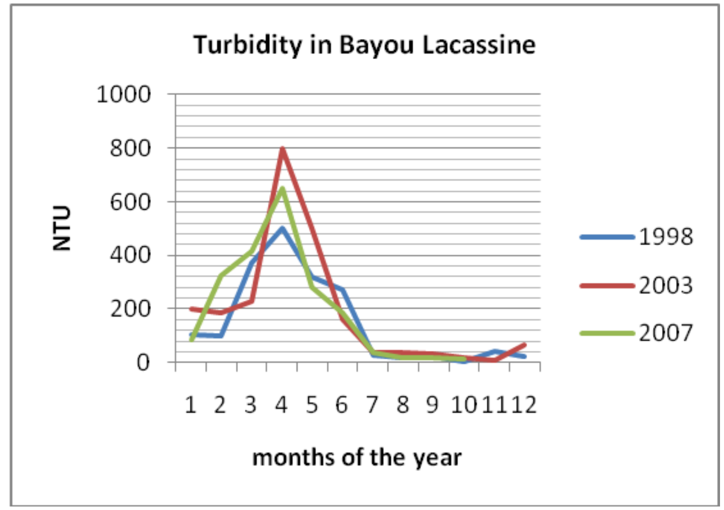


Figure 19

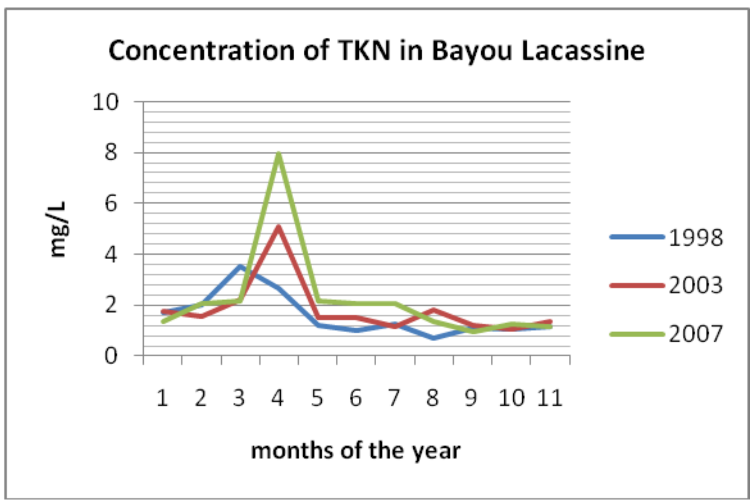


Figure 20

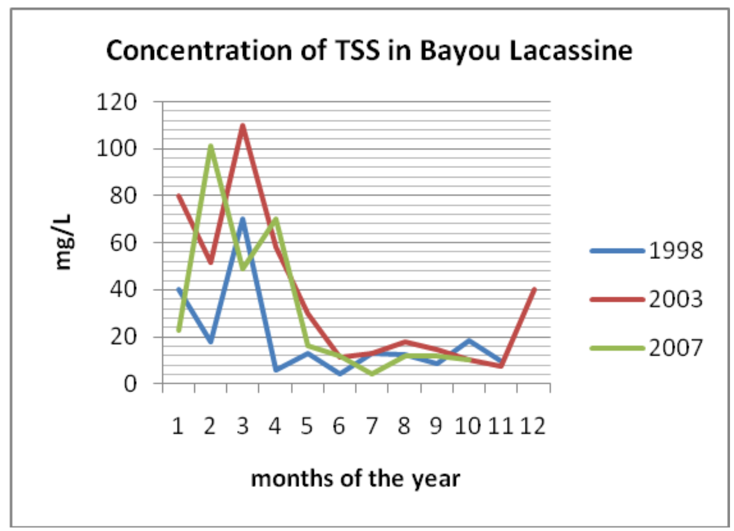


Figure 21

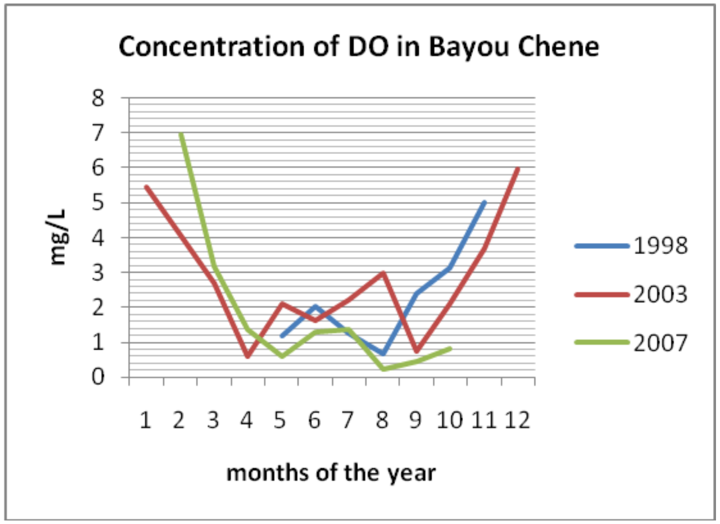


Figure 22

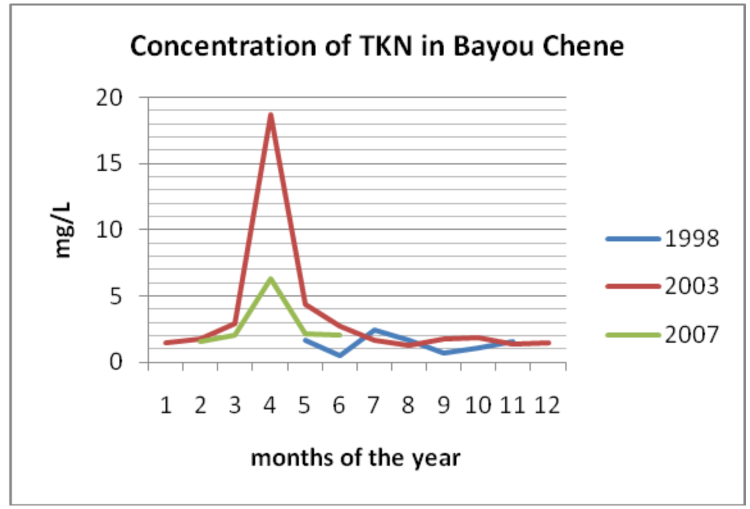


Figure 23

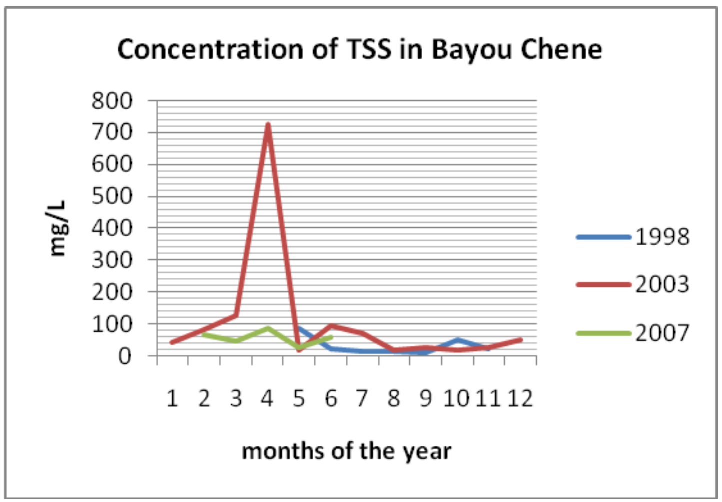


Figure 24

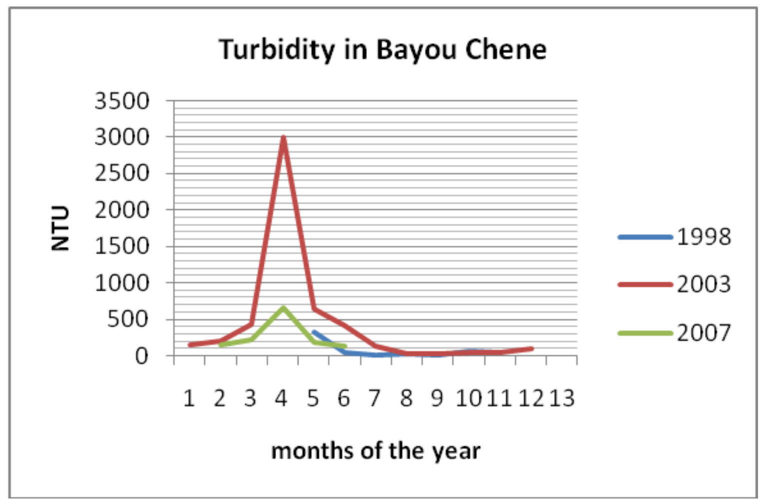


Figure 25

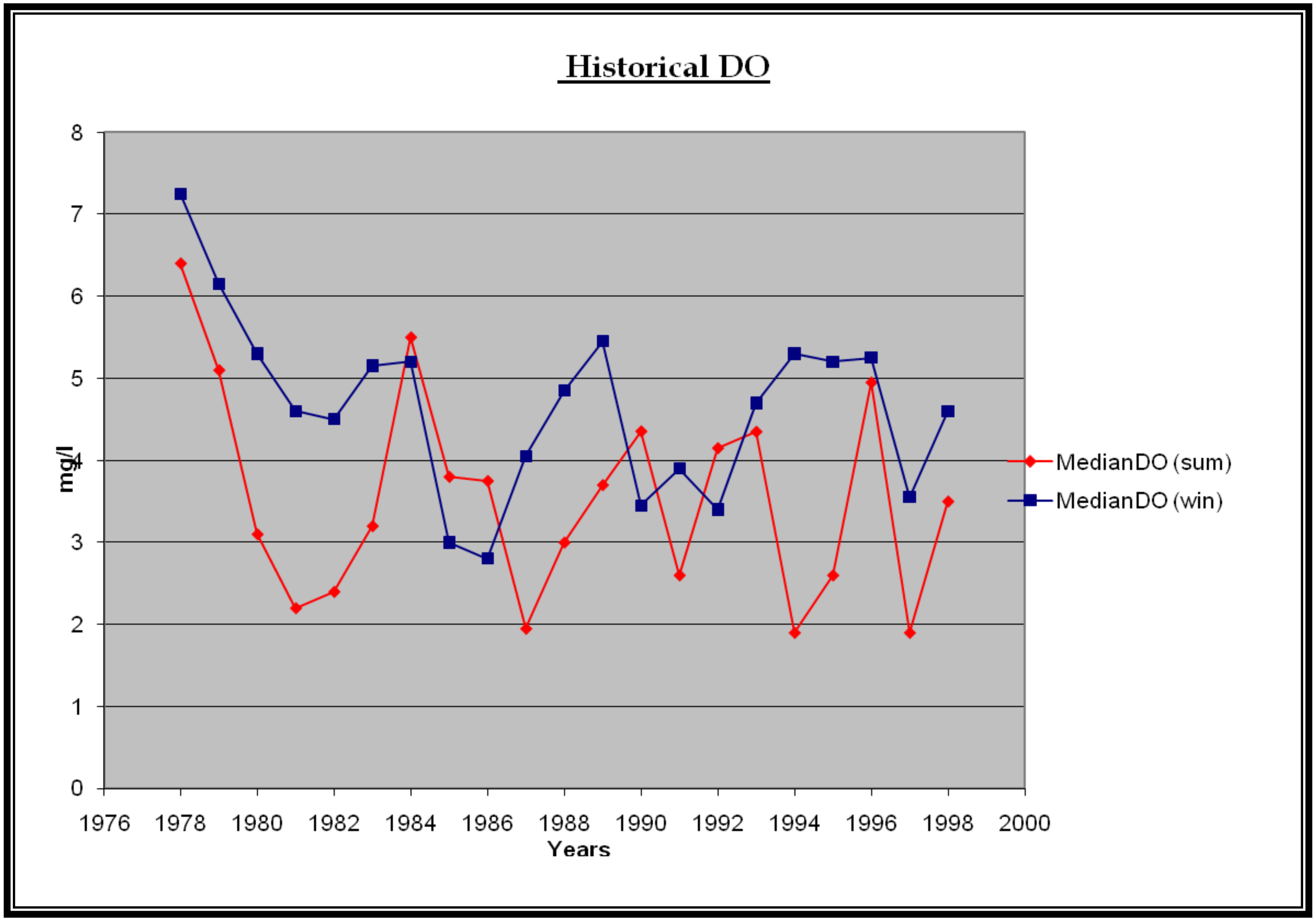

Historical DO
8
7
6
5
4
3
2
1
0
mg/l
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
Years
MedianDO (sum)
MedianDO (win)

Figure 26

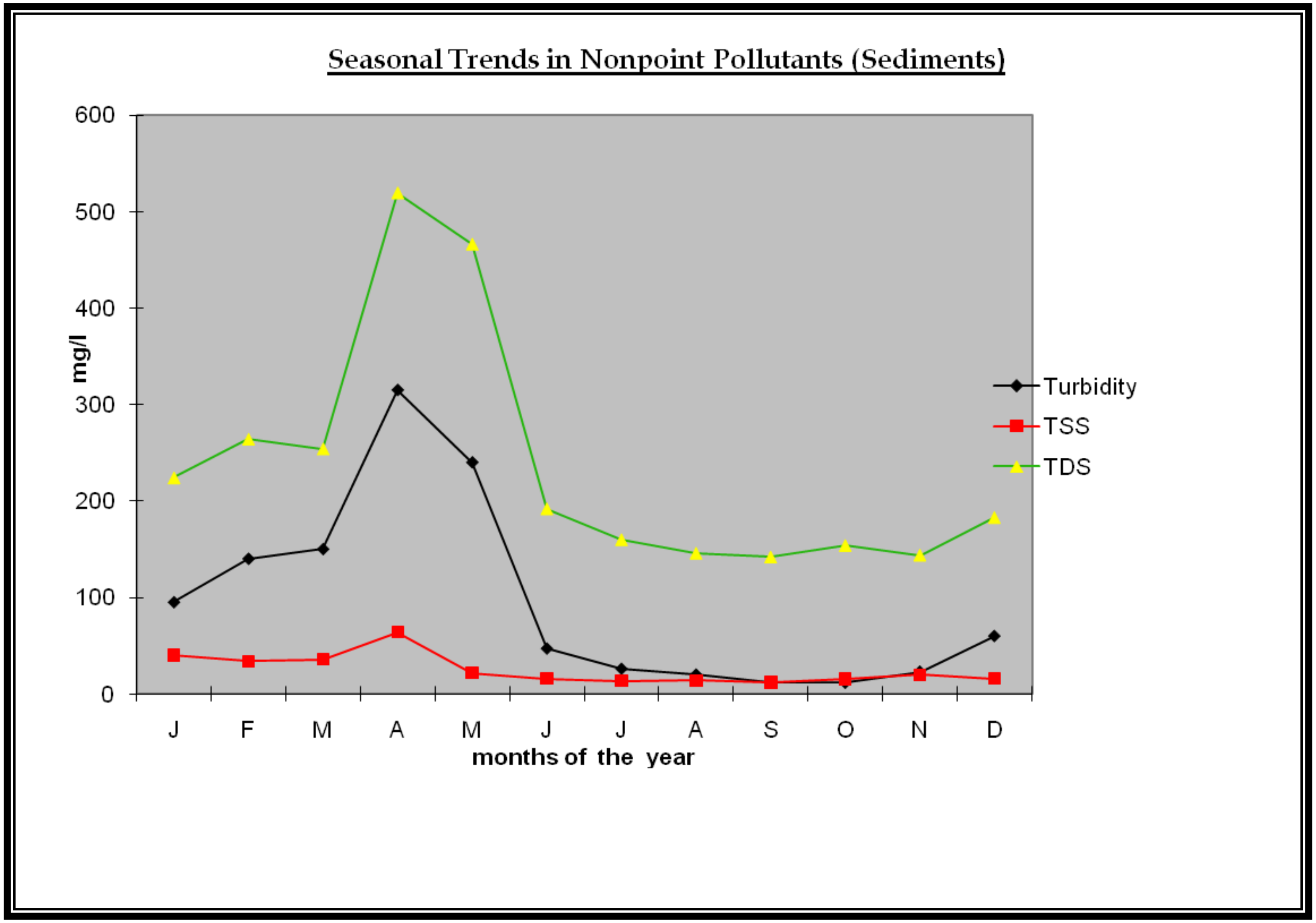

Seasonal Trends in Nonpoint Pollutants (Sediments)
mg/l
600
500
400
300
200
100
0
J
F
M
A
M
J
J
A
S
O
N
D
months of the year
Turbidity
TSS
TDS

Figure 27

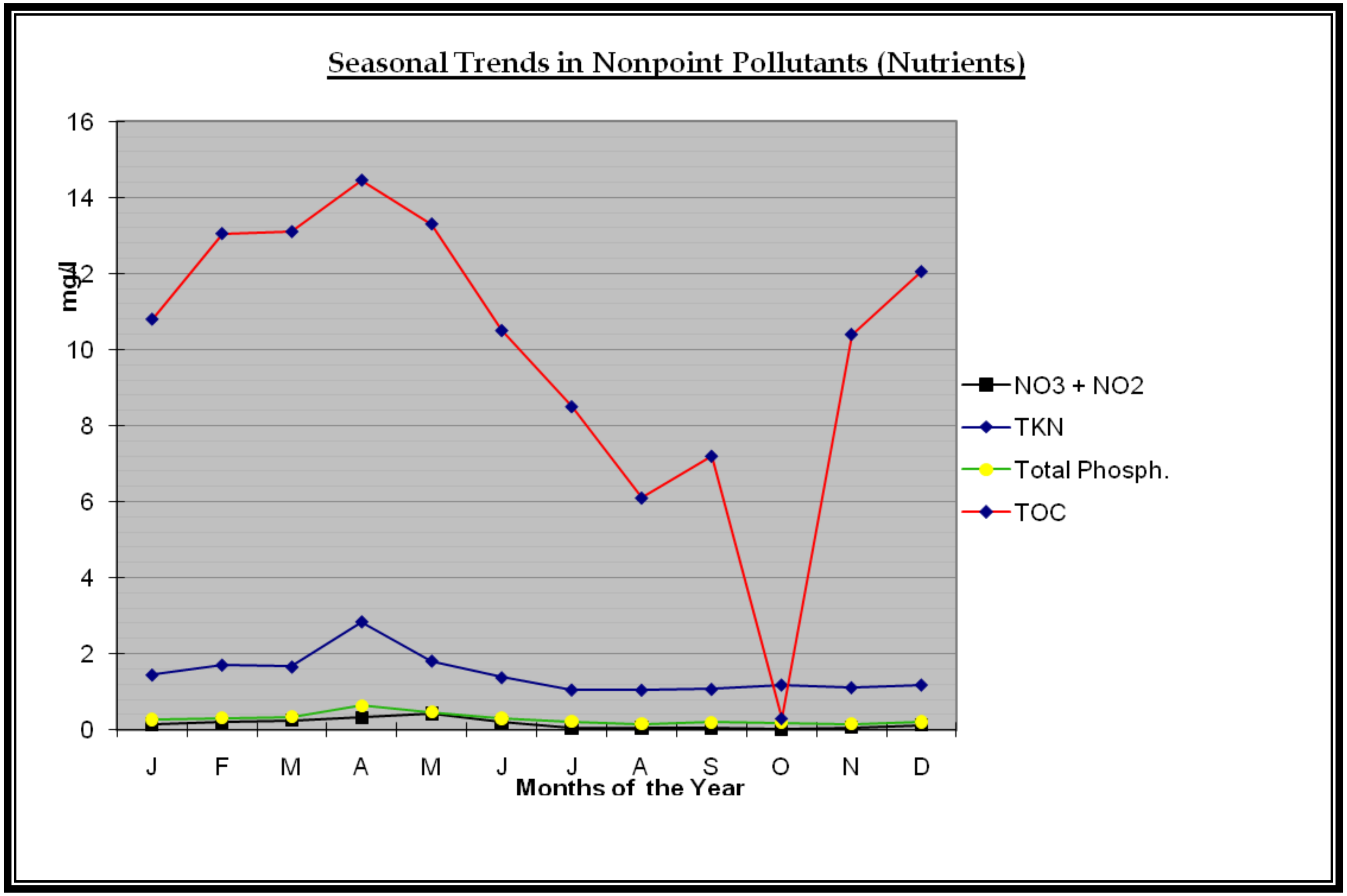

Seasonal Trends in Nonpoint Pollutants (Nutrients)
mg/l
16
14
12
10
8
6
4
2
0
J
F
M
A
M
J
J
A
S
O
N
D
Months of the Year
NO3 + NO2
TKN
Total Phosph.
TOC

Figure 28

6. 0 STREAM REACHES

In order to understand where along the bayou the largest load may be causing problems, the engineers that did the TMDL divided the bayou into sections, called stream reaches. The photographs, graphs and diagrams that have been included within this section of the watershed plan depict how the pollutant load is stored in the bayou and where it may be coming from within the watershed.

There were 41 stream reaches defined by the model for Bayou Lacassine and Bayou Chene. The Bayou Lacassine system has two major headwaters; the East Bayou Lacassine, which flows through the town of Welsh, and the West Bayou Lacassine, which passes through the village of Lacassine. Stream Reaches 0-10 are aligned along the East Bayou Lacassine tributary, from just South of I-10 to the confluence with West Bayou Lacassine. Here the channel of the tributary is relatively deep, and relatively narrow. The channel becomes deeper near the confluence with West Bayou Lacassine (see Figure 32). Land-use is dominated by rice production, some of it fairly intensive (ref section 3, Jefferson Davis Parish).

The West Bayou Lacassine (see Figure 32) tributary covers stream reaches 13-18, and is wider than East Bayou Lacassine, and generally deeper. The channel becomes wide and shallower near the confluence with West Bayou Lacassine. Land-use is varied and includes pastoral agriculture, forestry, urban areas, as well as some rice production.

The main Bayou Lacassine extends from the confluence of West and East Bayou Lacassine, down to the intracoastal canal. This includes part of the Lacassine national wildlife refuge. The upper part of the Bayou Lacassine (reaches 19-32), above highway 14, is dominated by agriculture (mostly rice and crawfish). The upper river channel of the Bayou Lacassine is deeper than the headwaters and significantly wider.

Figure 29: Tributary into West Bayou Lacassine

This section of the watershed includes unmarked tributaries 1 and 2, and the confluence with Bayou Chene.

The lower part of Bayou Lacassine south of Highway 14 (reaches 33-41) is relatively shallow and wide. The channel includes a number of islands, and the region around the watershed becomes more characterized by swamp towards the Intracoastal waterway (see Figure 33).

Section 6.1 TMDL Model Results

Figure 34 shows the calculated loading by stream reach, generated by the model. The data shows an overall increasing trend in loading with stream reach, from relatively low values of load in reaches 1-12 (around 500-1500kg/day), through to the highest values at reaches 40-41 (around 8,000-13,000 kg/day). It is important to realize this data reflects where the load is stored in the bayou and is exerting a demand on the oxygen levels in the bayou, and not necessarily where it originated from. Load is associated with nutrient laden sediments, which may be deposited downstream from where they entered the system. In this way the data actually reflects not loading to the system, but where within the bayou, the largest demand of oxygen is being measured. When an oxygen demanding load is exerted from deposited sediments, it is defined as benthic, or sediment oxygen demand (SOD). SOD can represent historical loading and resuspended sediment.

The exerted load/surface area of stream reach/day is plotted in figure 35, and shows a very different pattern. The exerted loading by stream reach is dominated by a peak at around 18 – 25, with smaller peaks at 12 and 40 and a slight attenuation from the headwaters to the bottom of the watershed. The vector diagrams on pages 35-37 show a loading peak in the area just below the confluence of the headwaters (East and West Bayou Lacassine), including the confluence with Bayou Chene. The model results suggest a significant proportion of the load is exerted in this area. But how much of this load is benthic load, or SOD? This means that the sediments stored around reaches 18-25 pull a lot of oxygen out of the water, but it still does not tell us where these sediments come from.

Figure 36 shows the load calculated per m2 stream reach without SOD. It can be seen that the highest loading is exerted in reaches 1-9 (which is East Bayou Lacassine ref. figure 29), but this load is actually relatively low compared to the peak calculated for total exerted load including SOD. This suggests that a large proportion of the total load exerted is accounted for by SOD. The peak in reaches 1-9 also suggests that, of that non-SOD load, a significant amount is exerted in East Bayou Lacassine.

To summarize the analysis of the loading data; there seems to be an elevated level of loading in East Bayou Lacassine, but the most significant peak in the load exerted is an SOD load occurring between stream reaches 19-25. This loading could be due to deposition of oxygen demanding sediments either from further upstream, or a historical build up of loading which is being resuspended. This area also seems to be just downstream from the area of 'highly erodible soils' identified in section 4, which provides supporting evidence that this is an area of concern. The land-use data (ref. Section 3) shows that this area is under relatively intensive agricultural use (relative to the rest of the sub-segment), and that rice/soybean cultivation is the dominant agricultural land-use.

The aerial photograph in Figure 7 may illustrate the problem in another way. The image shows agricultural fields surrounding a low-lying swampy bayou. The water quality data indicates that during the spring months, sediments and nutrients are discharges from these agricultural fields down to Bayou Chene and Lacassine. The swamps that surround the bayous also provide a high organic load to the bayous from natural sources, so all of this material combines and settles on the bottom of the bayous. They exert an oxygen demand that is high enough that the bayous can not maintain their water quality standards so they remain on the impairment list.

Figure 30 is a diagram which illustrates the main stem and tributaries of Bayou Lacassine in addition to some of the sampling locations from the stream survey.

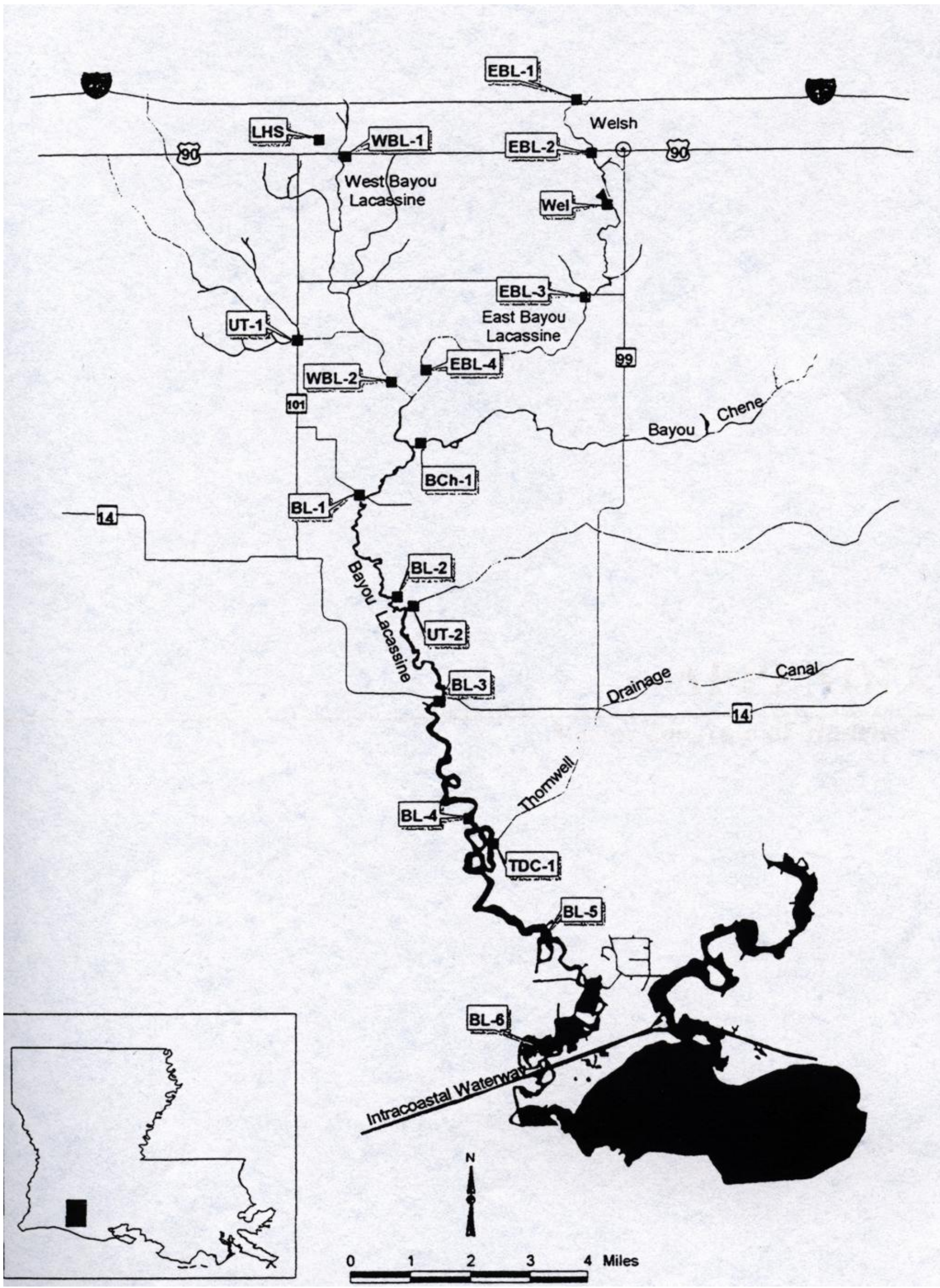

EBL-1
Welsh
LHS
WBL-1
EBL-2
90
West Bayou
Lacassine
Wel
EBL-3
East Bayou
Lacassine
UT-1
EBL-4
WBL-2
99
101
Bayou
Chene
BCh-1
BL-1
14
BL-2
Bayou
Lacassine
UT-2
BL-3
Drainage
Canal
Thornwell
BL-4
TDC-1
BL-5
BL-6
Intracoastal Waterway
N
0
1
2
3
4 Miles

Figure 30

Section 6.2 Analysis of Field Parameters

Water velocity is potentially a very important field parameter, as sudden decreases of water velocity will naturally result in the deposition of sediments, leading to increased benthic loading. A drop in water velocity around reaches 25-30, would for example, support the theory of high sediment deposition (and therefore SOD) in this area. Water velocity data was analyzed and appeared to indicate uniform low flows over the sub-segment. What little variation in flow that was detected is more likely to be accounted for by instrument variation than real changes in water flows.

At deeper regions of the watershed, the DO values tend to be less. This probably reflects the effect of depth on the reaeration equation. If the water column becomes deeper, DO values tend to be lower due to the greater extent of lateral diffusion in the water column. This is why dissolved oxygen alone cannot be used to assess loading in any part of the watershed.

Section 6.3 Discussion of 'Hotspots'

It is obviously difficult, considering all of the complexities of data interpretation, to identify specific problem areas in the Bayou Lacassine watershed. However there is cumulative supportive data to suggest that the upper reaches of East Bayou Lacassine, and the Upper main channel of Bayou Lacassine, are the two regions where attention should be focused on reducing sediments and nutrient loads. The vector diagrams on pages 35-37 are used to illustrate the link between the areas of high SOD loading, the land use data, and the 'hotspots'.

Section 6.4 Where Should the Efforts be Concentrated?

As both these regions of the watershed are characterized by intensive rice production, the most effective application of Best Management Practices to the Bayou Lacassine watershed would be in rice, focusing in these two regions. More specific information on best management practices is given in section 8.

Sections 6.5 Discussion of Vector Diagrams

Looking at the combined vector diagrams, it is evident that while the most intensive agricultural land-use is occurring in reaches 1-25, the greatest loading is occurring in the lower part of the watershed – peaking during reaches 40-41. There are a number of factors which need to be understood here. The first is the importance of benthic loading, or sediment oxygen demand (SOD). SOD refers to the effect of resuspended sediments causing a Bio-chemical oxygen demand, which mostly reflects a historical deposition of sediments. This may be thought of as distinct from current loading, which represents the bio-chemical oxygen demand resulting from current rates of sediment/nutrient loading. The model makes no distinction between these two kinds of loading, and SOD and actual loading are considered as a sum total loading per stream reach. However if you consider the possibility that a significant portion of the total calculated loading is made up of SOD, and couple this with the realization that SOD reflects historical conditions, the implication is that the picture of current loading conditions may be distorted by historical trends.

Another concept to understand is the influence of reach size in affecting the observed pattern of loading. The model measures total loading per reach, regardless of reach size. In fact the reaches tend to get very wide towards the lower reaches, and therefore the loads are larger due to the much greater volume of flow. To avoid this distortion effect of stream reach width, the loads were converted to mgO2/m2/day. When the effect of increased surface area of stream reach is normalized, the pattern of loading is quite different. The greatest loading occurs in the upper part of the main Bayou Lacassine, around reaches 22 to 29. This area has a high intensity of rice agriculture and the Bayou Chene flows into this region.


Figure 31: Photo of East Bayou Lacassine

Figure 32 West Bayou Lacassine

Figure 33 Lower Bayou Lacassine

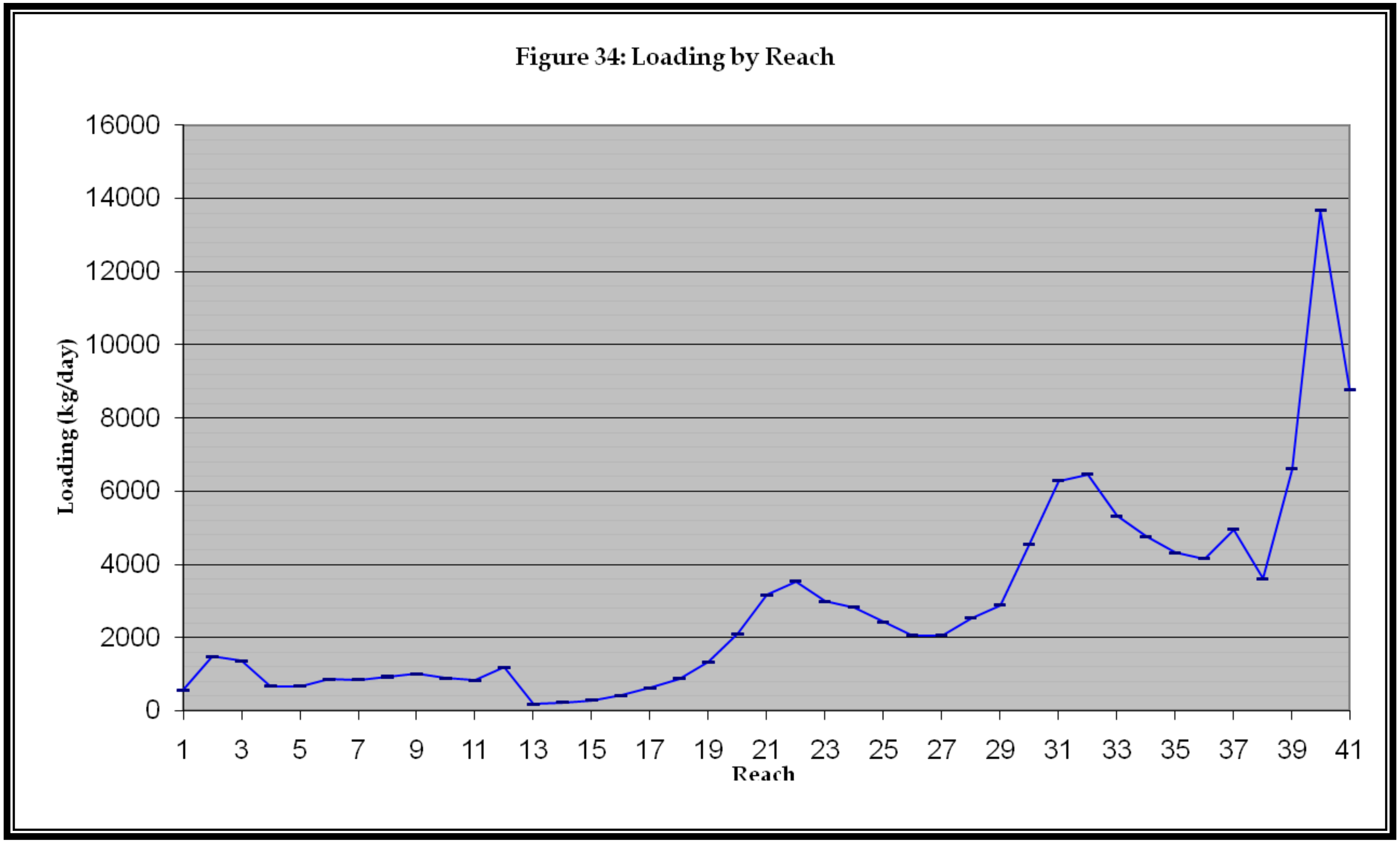


Figure 34: Loading by Reach
Loading (kg/day)
16000
14000
12000
10000
8000
6000
4000
2000
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
Reach

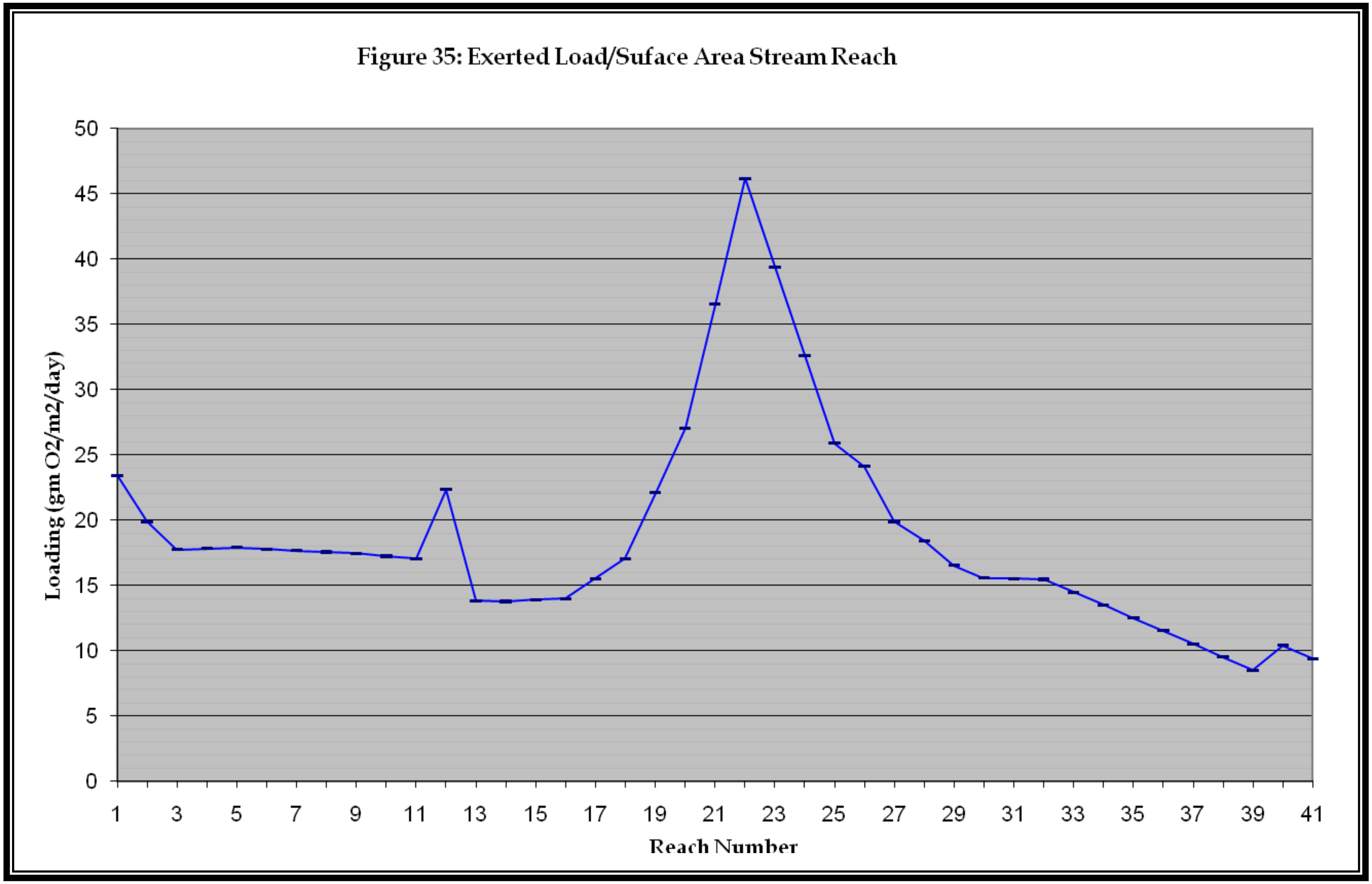


Figure 35: Exerted Load/Suface Area Stream Reach
Loading (gm O2/m2/day)
50
45
40
35
30
25
20
15
10
5
0
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
Reach Number

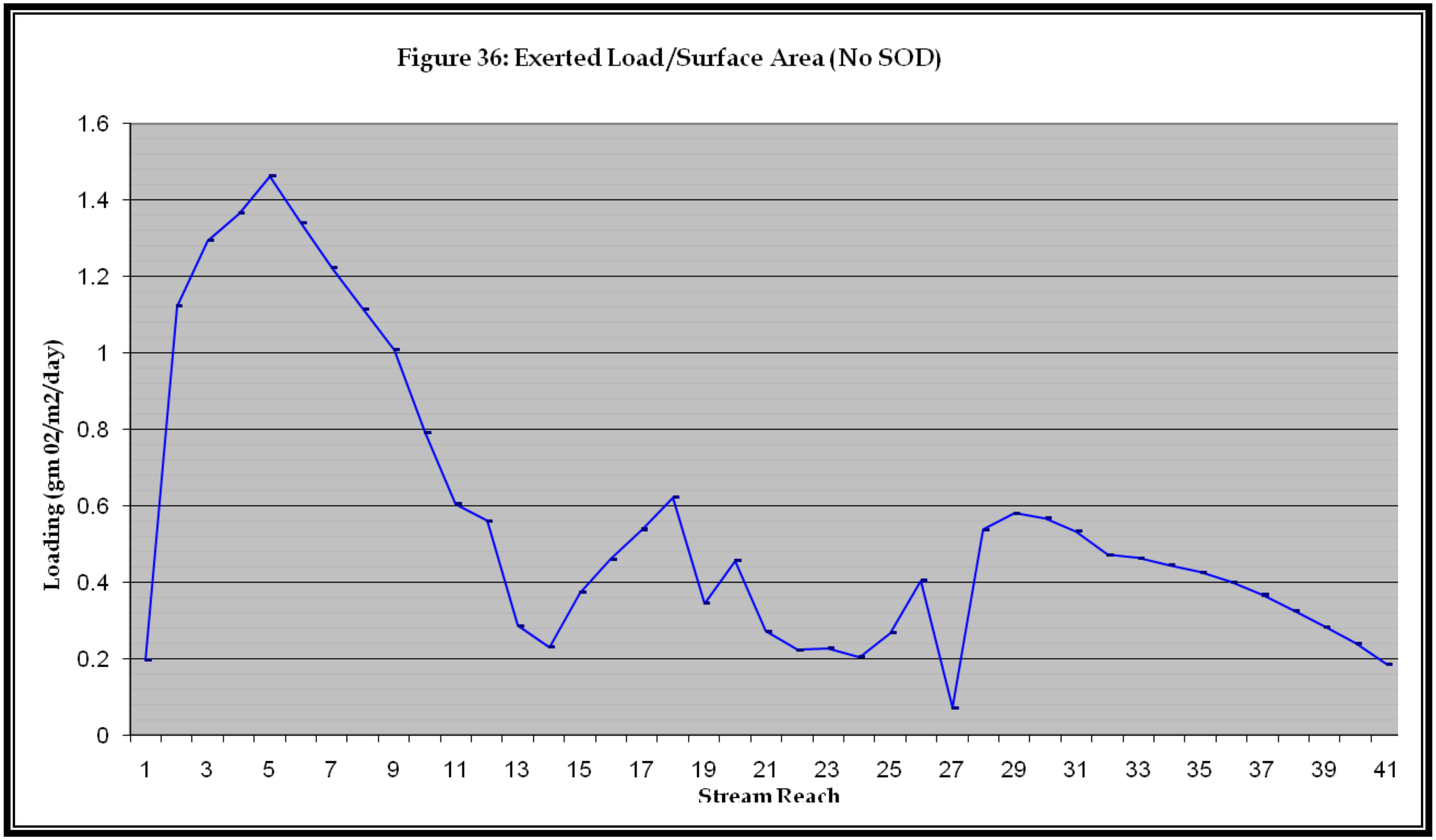
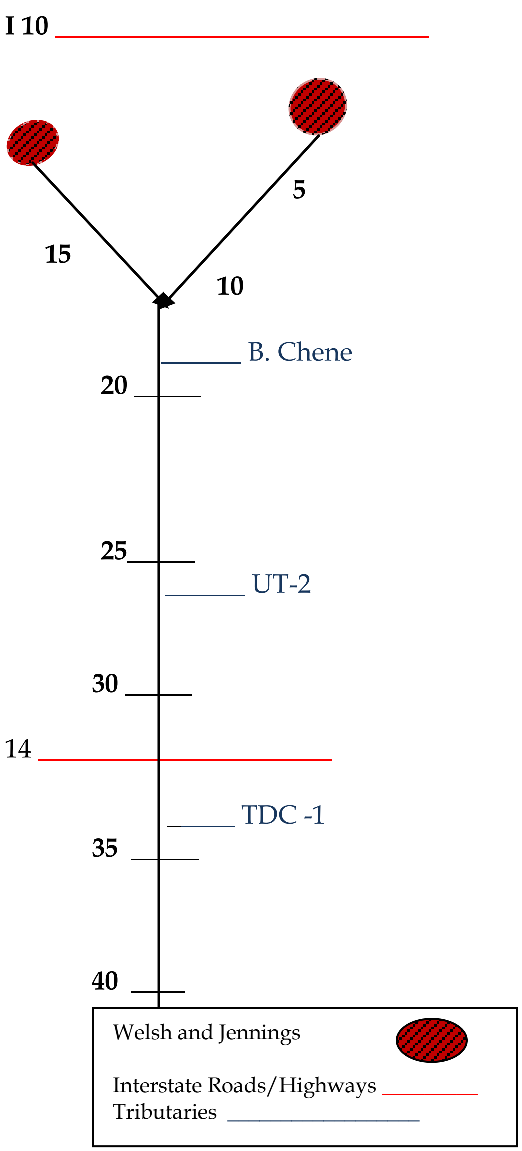


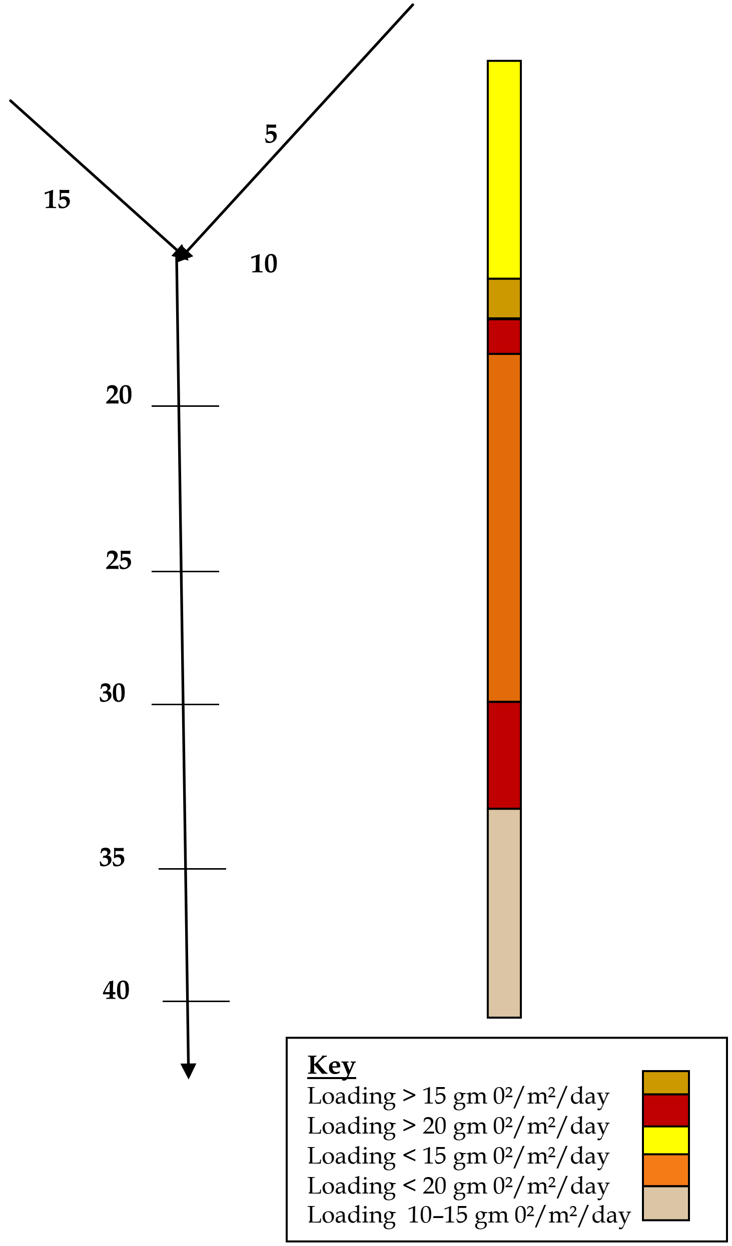
Figure 36: Exerted Load/Surface Area (No SOD)
Loading (gm 02/m2/day)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31 33 35 37 39 41
Stream Reach

Vector Diagrams – Exerted Load/Surface Area by Stream Reach and Land-Use

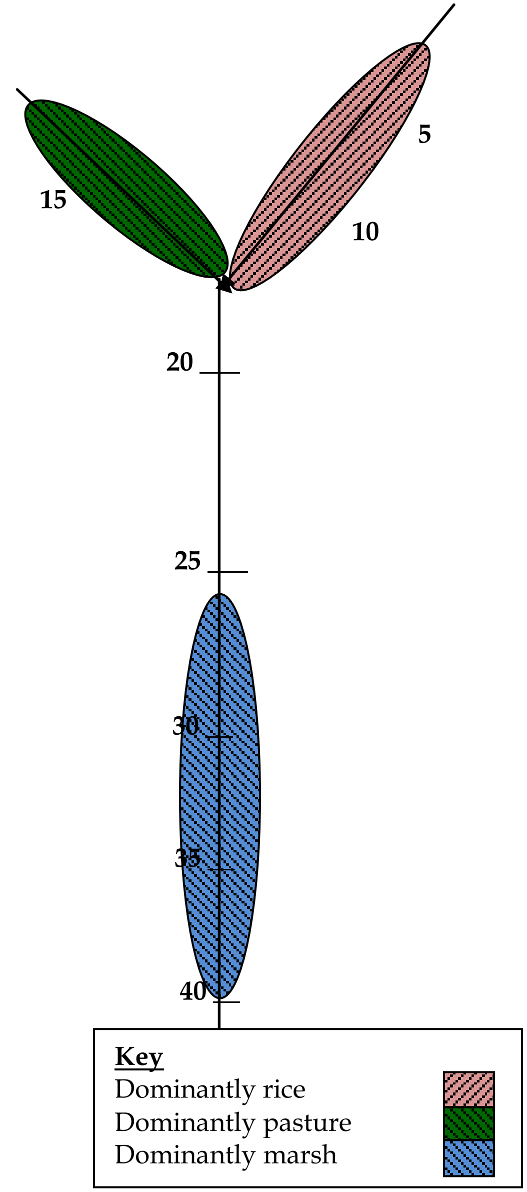
1. Bayou Lacassine



2. Bayou Lacassine loading data

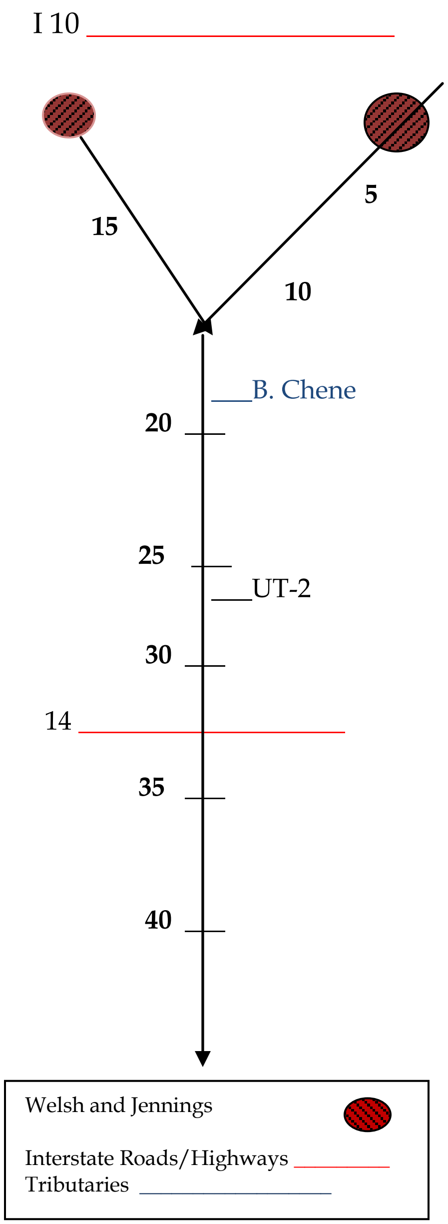


3. Bayou Lacassine Landuse

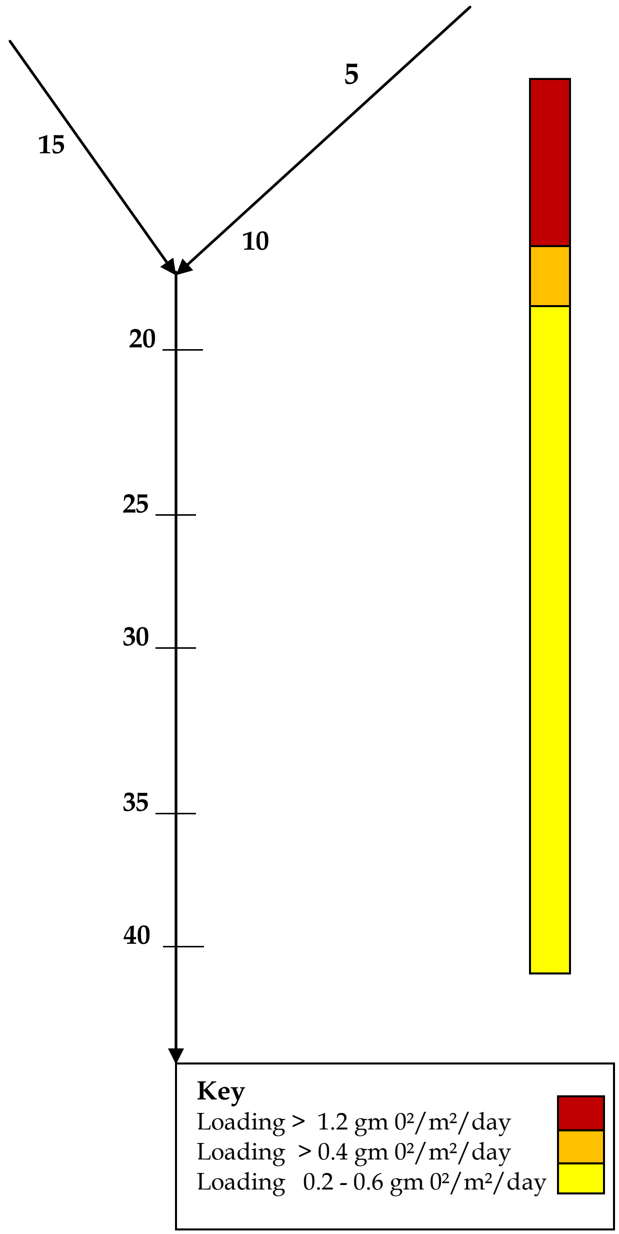


Vector Diagrams – Loading by Reach (no SOD) and Land-Use

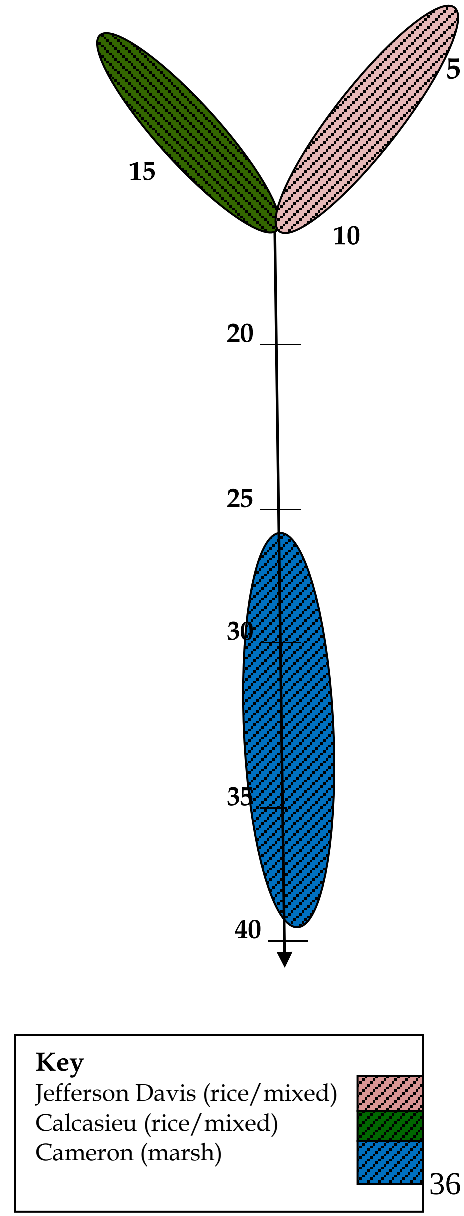
1. Bayou Lacassine



2. Bayou Lacassine Loading (no SOD)

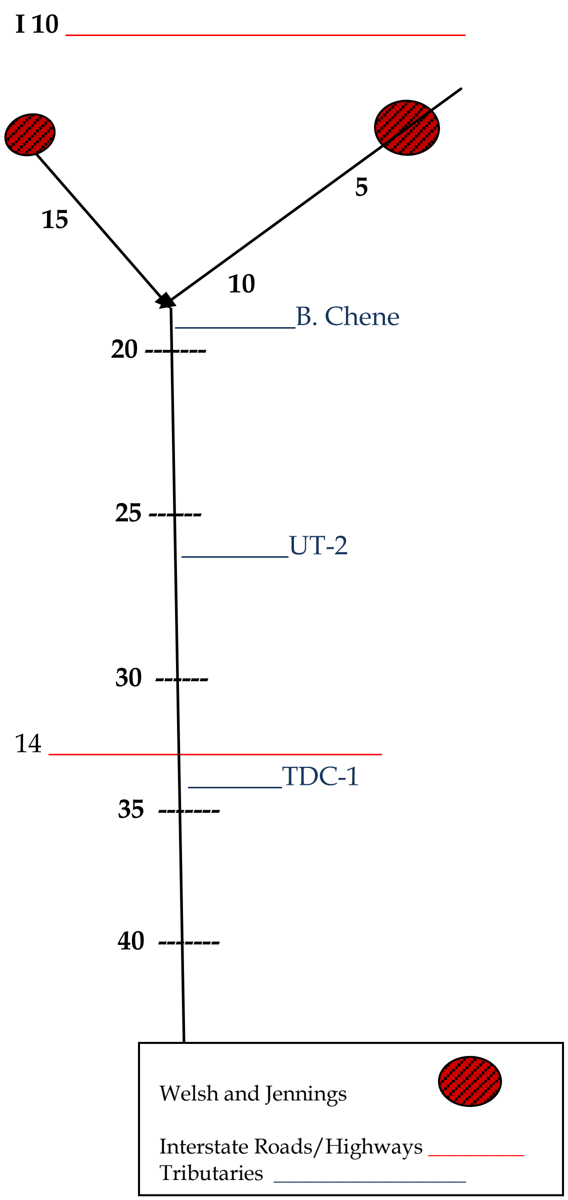


3. Bayou Lacassine Landuse

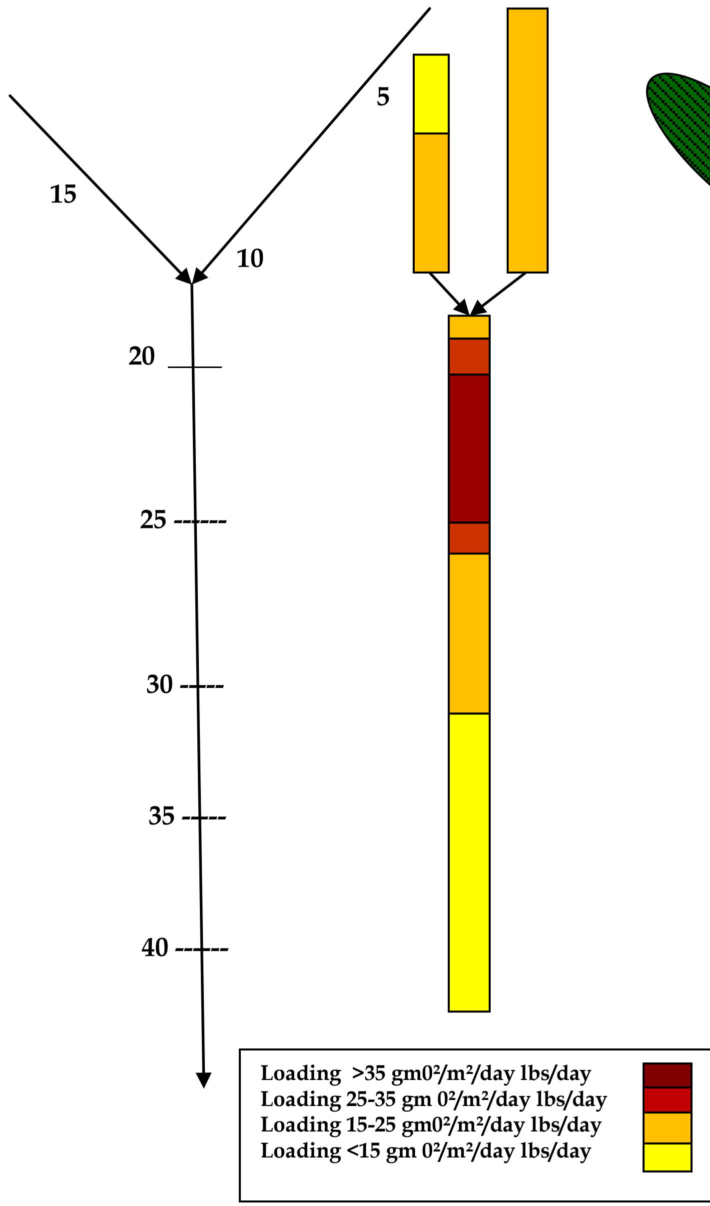


Vector Diagrams – Loading by Stream Reach and Land-Use

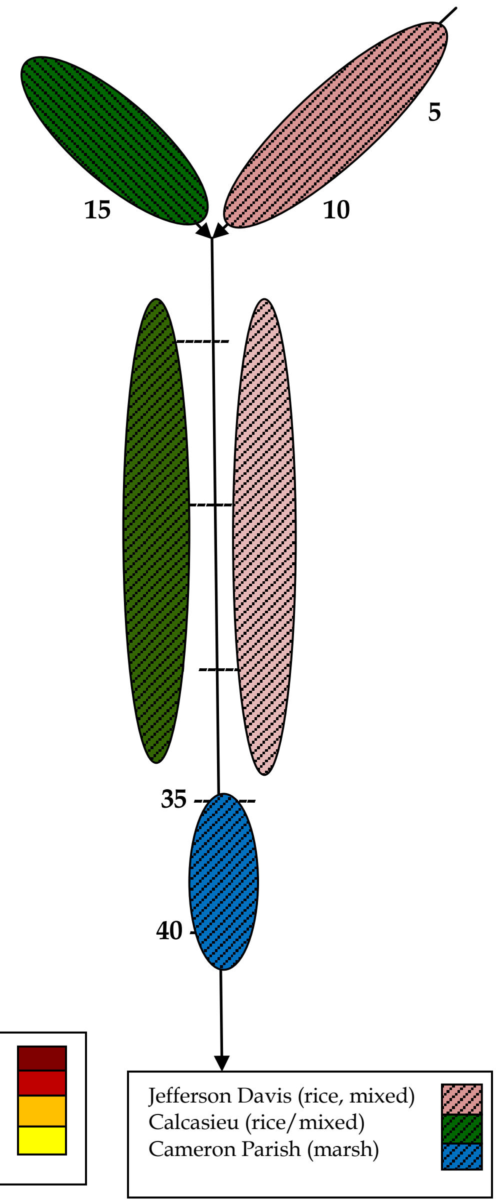
1. Bayou Lacassine



2. Bayou Lacassine Loading Data



3. Bayou Lacassine Landuse



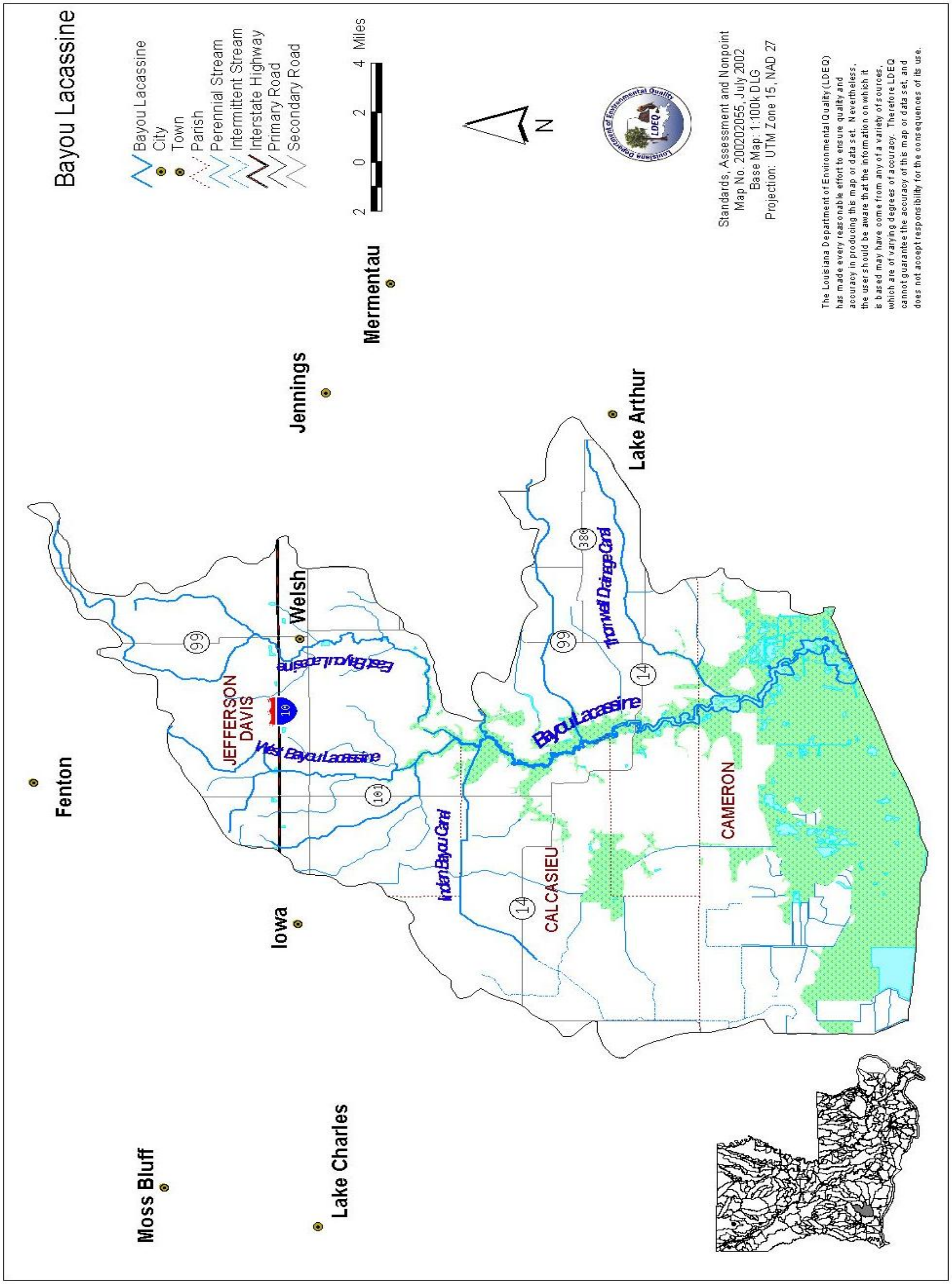

Bayou Lacassine
Bayou Lacassine
City
Town
Parish
Perennial Stream
Intermittent Stream
Interstate Highway
Primary Road
Secondary Road
2 0 2 4 Miles
N
Standards, Assessment and Nonpoint
Map No. 200202055, July 2002
Base Map: 1:100k DLG
Projection: UTM Zone 15, NAD 27
The Louisiana Department of Environmental Quality (LDEQ) has made every reasonable effort to ensure quality and accuracy in producing this map or data set. Nevertheless, the user should be aware that the information on which it is based may have come from any of a variety of sources, which are of varying degrees of accuracy. Therefore LDEQ cannot guarantee the accuracy of this map or data set, and does not accept responsibility for the consequences of its use.
Moss Bluff
Lake Charles
Fenton
Iowa
Jennings
Mermentau
Welsh
Lake Arthur
JEFFERSON DAVIS
CALCASIEU
CAMERON
West Bayou Lacassine
East Bayou Lacassine
Bayou Lacassine
Indian Bayou Canal
Thornwell Drainage Canal
10
99
101
14
380

Figure 37

Table 1-5 .Numerical Criteria and Designated Uses A - Primary Contact Recreation; B - Secondary Contact Recreation; C - Propagation of Fish and Wildlife; D - Drinking Water Supply; E - Oyster Propagation; F - Agriculture; G - Outstanding Natural Resource Waters; L - Limited Aquatic Life and Wildlife Use									
			Criteria						
Code	**Stream Description**	**Designated Uses**	**CL**	**SO_4**	**DO**	**pH**	**BAC**	**°C**	**TDS**
050601	Lacassine Bayou – Headwaters to Grand Lake	A B C F	90	10	[16]	6.0-8.5	1	32	400
050603	Bayou Chene - includes Bayou Grand Marais	A B C F	90	10	5.0	6.5-9.0	1	32	400

7.0 Linking Water Quality Standards to the Designated Uses

All of the previous discussions in the watershed plan have been aimed at explaining why Bayou Lacassine and Bayou Chene do not meet their water quality standards and their designated uses. Water quality standards are the criteria by which the state determines whether the water body is meeting its designated uses. Protecting the designated uses of water bodies is the primary purpose of the Clean Water Act. For Bayou Lacassine and Bayou Chene the designated uses are primary and secondary contact recreation, fish and wildlife propagation and agriculture use.

Table 1-5 lists those designated uses and also includes the water quality standards that Louisiana has within it regulations to protect those uses, which includes chloride, sulfate, dissolved oxygen (DO), pH, temperature, total dissolved solids (TDS) and bacteria. The water quality data that LDEQ collects and described in Figure 3 illustrates the two sub-segments that describe Bayou Lacassine and Bayou Chene, 050601 and 050603, respectively. A seasonal water quality standard applies to the Bayou Lacassine in the summer months and a 5 mg/L standard applies in the winter months. The Bayou Chene has a year round standard of 5 mg/L. Bayou Lacassine and Bayou Chene have a water quality standard of 400 mg/L of total dissolved solids and the historical water quality data indicates that it often exceeds that during the month of April.

These water quality criteria are the basis from which water quality improvement will be measured. LDEQ will continue to sample the bayous on the 4-year cyclic process and analyze data to determine if water quality is improving as a result of increased BMP implementation, educational efforts and watershed planning and implementation activities.

Section 7.1 Strategy for Improvement

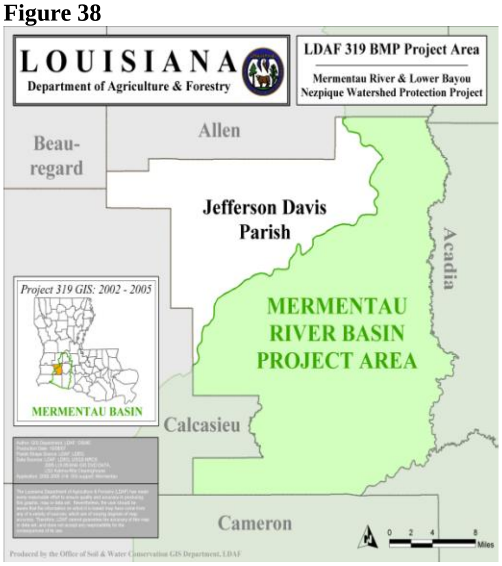
The complexity of the system and the uncertainties in the data cannot be over-stated. However there is clearly a problem with the dissolved oxygen values in the Bayou Lacassine, and the accumulated evidence of this plan strongly suggests that the implementation of best management practices to reduce loading for rice production in the upper reaches of Bayou Lacassine (particularly after the confluence of East and West Bayou Lacassine, and Bayou Lacassine) is the best strategy to improve the water quality. More specific information on recommended BMPs is provided in the next section (Section 8).

8.0 BMP- Achievable Goals For Watershed Implementation

8.1 BMP Implementation through Local Soil and Water Conservation District

In 2007, the Office of Soil and Water Conservation (OSWC) at the Louisiana Department of Agriculture and Forestry utilized a portion of the incremental funds provided by Section 319 of the Clean Water Act to implement a cost-share program for farmers in the Jefferson Davis Parish that included the Bayou Lacassine Watershed. With these funds, the farmers in this project area implemented more than 12,000 acres of conservation crop rotation, 10,600 acres of seasonal residue management, 2900 acres of nutrient and pest management, 953 acres of irrigation land-leveling, 197 acres of dry seeding, 417 acres of irrigation water management, installed 22 grade stabilization structures and 1080 acres of shallow water management for wildlife.

Figure 38



The map shows the location of farms where BMPs were implemented with incremental Section 319 funds. The red squares indicate actual farms where BMPs were implemented and the blue squares indicate farms where contracts were written, but no BMPs actually put on the ground. This work was completed under a Section 319 cost-share project managed by OSWC. Field work was accomplished through the collaborative work of technicians from the local Soil and Water Conservation Districts and the USDA Natural Resource Conservation Service (NRCS).

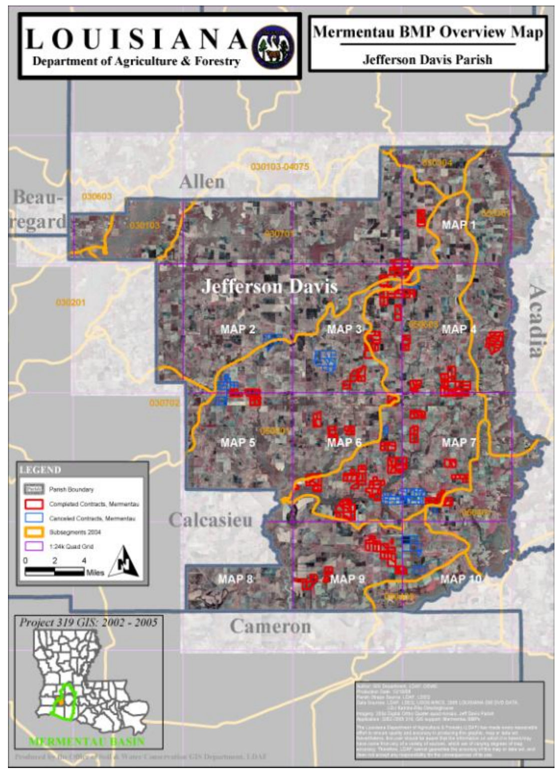


Figure 39

Within these same two watersheds, USDA-NRCS has done extensive work on BMP implementation in the Bayou Lacassine Watershed (050601). During the past five years, they have assisted landowners to implement more than 11,699 acres of practices. LDAF has assisted landowners to implement an additional 39,691.6 acres of practices and participants in the Master Farmer Program have implemented an additional 576 acres of BMPs. This is a combined effort of 51,967 acres of BMPs implemented within this watershed since 2004. There have been similar efforts made in the Bayou Chene watershed (050603) on agricultural BMP implementation. NRCS has assisted landowners to implement more than 5604.5 acres of BMPs. LDAF has assisted landowners to implement an additional 61,284.7 acres of BMPs for a total of 66,889.2 acres of practices implemented since 2004. This means that since the watershed plan was written, there has been more than 118,856 acres of BMPs implemented within the Bayou Lacassine and Bayou Chene watersheds. If we look back at Tables 1.2 and 1.3 on page 10, it is possible to make a rough estimate of the percentage of lands within these watersheds that may have been treated with BMPs. Table 1.2 indicates that the Bayou Lacassine watershed has 254,138 acres of which 161,103 is either in cropland or pasture. If we take a simple percentage, then approximately 32% of the watershed was treated during these past 5 years. Some of these practices were probably utilized on the same farms such as nutrient management, pesticide management and conservation crop rotation. From the list of BMPs implemented, more practices were implemented on croplands than pastures and hay lands.

If we apply the same type of calculations for Bayou Chene, we see that a larger percentage of the watershed has been treated with practices. Table 1.3 indicates that there are approximately 86,106 acres of land in Bayou Chene, 72,155 of which is either croplands or pastures. This would mean that approximately 85% of the agricultural land in Bayou Chene watershed had been treated with BMPs. There was extensive acreage of nutrient and pesticide BMPs implemented which may have been combined with residue management or conservation crop rotation which would drop this percentage to less than 50%. As local work groups continue to meet and discuss future actions that need to be taken and more water quality data is collected, it will become more apparent what types of BMPs need to be implemented and where they need to be targeted.

8.2 Best Management Practices

BMPs are practices which may be applied to agriculture and urban development, to control the generation of pollutants and their delivery of pollutants to the watershed. Although a wide variety of BMPs are available which may be applied to the Bayou Lacassine, specific BMPs designed to address the problems in Bayou Lacassine are recommended in this chapter.

8.3 Recommended BMPs for Bayou Lacassine.

A list of general agricultural BMPs is included in Appendix B. The accumulative evidence of the implementation plan indicates that focusing on flooded fields; particularly rice is what will be necessary to reduce the pollutant loads in the watershed. Seasonal peaks in nutrients and turbidity match the spring discharge in rice production after land leveling (mudding in) and seeding. Mudding in a rice field involves flooding the field and running disks through the mud and water, for the purpose of leveling the ground. Discharges of suspended solids are magnitudes greater during this spring discharge event than over the rest of the year. The summer and fall discharges are relatively clean; in fact there is evidence that in the bayou, the July discharge has an effect of replenishing dissolved oxygen levels in the system. The key to reducing the critical NPS runoff in the Bayou Lacassine watershed to the levels prescribed in the TMDL is to eliminate the spring discharge of muddy water from the rice fields. The application of BMPs will allow farmers to circumvent the muddy discharges that occur during planting season. Instead of ‘mudding in’, the rice farmers can utilize precision leveling techniques. And

Figure 40

instead of aerial seeding into flooded fields, farmers can knife in rice seed into a dry seedbed.

These measures will supply methods to eliminate the spring discharge, which represents the major NPS loading which is occurring in the watershed. The retention of water for 10-15 days prior to release has been recommended before, but storms can stir sediment up in the fields at any time. The new varieties of rice that allow for dry planting should eventually result in less water quality problems from rice farming in southwestern Louisiana.

In soybeans, conservation tillage practices help retain soils during the years of soybean rotation. Many farmers in the watershed till the fields 4 times, twice during the spring and twice again during the fall after harvest. By simply eliminating the fall tillage operations and leaving the crop residue on the field, a significant amount of soil is retained on the fields over the winter months when the area experiences heavy and frequent rain events.

In addition to these BMPs, the Louisiana Nonpoint Source Management Plan describes two management practices for rice which were developed and evaluated as methods to reduce the amount of sediment leaving the rice fields. These two management practices included:

1. Retention of flood water in a closed levee system for a specified period during and after the soil-disturbing activities (i.e. mudding-in); and
2. Clear water planting into a prepared seedbed.

The evaluation of these rice practices has indicated that sediments and nutrients could be reduced by 50-75% from the traditional 'mudding-in' practice. These are the types of steps that need to be taken by the rice farmers in the Bayou Lacassine and Bayou Chene watersheds to reduce the nonpoint source loads entering the bayous.

8.4 BMP Implementation to Achieve TMDL

This process of focused implementation of BMPs in 'hotspot areas' will be combined with constant monitoring of progress in water quality until the watershed is no longer listed on the 303(d) list for dissolved oxygen. Many BMPs increase yields and reduce pollutant loads. Soil erosion, which leads to sediment/nutrient loading, depletes agricultural land of valuable plant nutrients and reduces crop yields in the long term.

8.5 Cost of BMP Implementation

Best management practices have a wide range of costs, depending on whether it is a structural practice or requires extensive engineering for its implementation. BMPs such as pesticide and nutrient management are approximately $5 per acre; tillage practices range from $10-15 per acre but irrigation land-leveling can cost $200 per acre. Grade stabilization structures cost $650 each, based on 2008 estimated costs. Each farm has to be examined individually to determine which set of BMPs are necessary to reduce the sediment and nutrient loads. Each year, the USDA Technical Steering Committee has the opportunity to review these costs and see which BMPs will be recommended for the next fiscal year.

8.6 Watershed Coordination

Watershed coordination is the key to achieve water quality goals, relying upon local watershed coordinators and their partners that participate with them in the watershed groups. The watershed plan, Section 319 funds, USDA funds and the Master Farmer Program are components of the watershed implementation process. As LDAF continues to work through their local partners and landowners on BMP implementation, LDEQ will continue to monitor the waters to see if water quality is improving.

It may be necessary to implement additional water quality monitoring closer to the BMP implementation to determine whether water quality is improving. LDEQ will be working with LDAF and NRCS along with the watershed coordinators and local work groups to identify where additional water quality data collection may be needed to track success in watershed implementation.

9. 0 Problem Tracking and Evaluation

Program tracking will be done at several levels to determine if the watershed approach is an effective method to reduce nonpoint source pollution and improve water quality:

1. Tracking of actions outlined with the Watershed Management Plan (short-term);
2. Tracking of BMPs implemented as a result of Section 319, EQIP, or other sources of cost-share ant technical assistance within the watershed (short term);
3. Tracking progress in reducing nonpoint source pollutants, such as solids, nutrients, and organic carbon from the various land uses (rice, soybeans, crawfish farms) within the watershed (short-term);
4. Tracking water quality improvement in the bayou (i.e. decreases in total organic carbon, total dissolved oxygen) (short and long term)
5. Documenting results of the tracking to the Nonpoint Source Interagency Committee, residents within the watershed, and EPA (short and long term);
6. Submitting annual reports to EPA which summarize results of the watershed restoration actions (short and long term)
7. Revising LDEQ's web-site to include information on the progress made in watershed management plans, nonpoint source pollutant load reductions, and water quality improvement in the bayou (short and long term).

The timeline to implement these actions is on-going, with NRCS and LDAF working in the watersheds on an annual basis. LDEQ will return to the watershed by 2011 to sample the water body at the established sites again and see if water quality has improved as a result of watershed implementation. More intensive water quality sampling may occur during 2010 and 2011 to monitor success of the management strategy.

10. Pesticides

10.1 Pesticides Used in Rice Agriculture in the Mermentau Basin

The rice water weevil is a severe insect pest of rice in Louisiana. Until the registration for the use of Furadan (carbofuran) was revoked in the late 1990s, granular Furadan was the primary means of controlling the pest in Louisiana. Furadan was applied to flooded soils when densities of rice water weevil larvae exceeded an economic threshold. Four insecticides, Icon (fipronil), Karate (lambdacyhalothrin), Fury (zeta-cypermethrin), and Dimilin (diflubenzuron), have been registered for use against the rice water weevil since the registration of Furadan was revoked. Icon is a prophylactic seed treatment that must be applied before the rice is planted. The application timing of Karate, Fury, and Dimilin is critical and based on the density of adult weevils when the conditions for oviposition are present. Research is in progress to develop more precise application thresholds for Karate, Fury, and Dimilin (Stout et al., 2002).

10.2 Carbofuran

Carbofuran (CAS # 1563662 M.F. $C_{12}H_{15}NO_3$): Carbofuran is a broad-spectrum carbamate pesticide historically used to control rice weevils. Carbofuran has a half-life of 30 to 120 days, is moderately persistent in soil, is mobile in soil, and is water soluble, does not bind or adsorb to sediment or suspended particles, and has a high potential for groundwater contamination (Howard, 1991). Chemical hydrolysis and microbial processes in soil and chemical hydrolysis under alkaline conditions in water degrade carbofuran.

The use of the granular form of carbofuran was banned in the U.S. in 1994 and by the end of the 1998 rice season; LDAF reported no stocks of granular carbofuran were remaining at dealers in Louisiana. However, FIFRA Section 24(c) allows farmers to use any remaining product. The only current use of carbofuran in Louisiana requires approval from LDAF and allows for the application of liquid formulations to cotton and wheat.

Total Maximum Daily Loads (TMDLs) have been established for carbofuran in the Mermentau River Basin where it affects the propagation of fish and wildlife, as well as oyster propagation in Coastal Bays and Gulf Waters. Rice farming is the primary source of carbofuran in the Mermentau and Vermilion-Teche River Basins. There are no point sources of carbofuran in the Mermentau Basin.

The load allocation for carbofuran is variable depending on flow. The chronic numeric target in freshwater (0.13 ug l^{-1}) was based on *Ceriodaphnia dubia*. The chronic numeric target in marine water (0.23 ug l^{-1}) was based on *Penaeus dourarum*. If the freshwater environment is protected, the marine environment should be protected as well since rice is not grown in marine environments and additional contaminant should not be added. Therefore, the chronic numeric targets in freshwater and stream flow have been used to calculate carbofuran loads. The waste load allocation for FMC outfall 001 is 0.00004 lbs/day and for outfall 002 is 0.000009 lbs/day. In addition to the TMDL values, the introduction of carbofuran resulting in local concentrations exceeding the numeric target will not be authorized.

United States Geological Survey (USGS) carbofuran monitoring data from 1998 to 2000 indicates Bayou Lacassine near Lake Arthur, LA, is fully supporting but has had at least 1 exceedance.

Since granular carbofuran is no longer produced and other forms have restricted use application, attainment of objective levels is expected.

10.3 Fipronil

Fipronil (CAS # 120068-37-3 M.F. $C_{12}H_4Cl_2F_6N_4OS$): Fipronil (ICON), is a broad-spectrum penylpyrazole insecticide commonly used in Louisiana as a prophylactic seed treatment to control insects that damage rice. Fipronil has been classified as a Class C (possible Human) carcinogen and ecological effects data show fipronil is toxic to upland game birds, fish, and aquatic invertebrates. Two fipronil metabolites, MB 46136 and MB 45950, are more toxic to freshwater invertebrates than the parent compound. Fipronil is stable to hydrolysis at mildly acid to normal pH and degrades slowly under alkaline hydrolytic conditions. USGS fipronil monitoring data (2000 and 2001) indicates that E. Bayou Lacassine W. of Welsh, is partially supporting.

Total Maximum Daily Loads (TMDLs) have been established for fipronil in the Mermentau River Basin. Rice farming is the only source of fipronil in the Mermentau River Basin. There are no point sources of fipronil in the Mermentau River Basin. The load for fipronil is variable depending on flow. The chronic numeric target in freshwater (2.3 ug l^{-1}) was based on *Lepomis macrochirus*. In addition to the TMDL values, the introduction of fipronil resulting in local concentrations exceeding the numeric target will not be authorized.

10.4 BMPs for Pesticides

Aventis Crop Science, who is the producer of the insecticide ICON® (Fipronil), has published some use restrictions for ICON® (Aventis, 2000). One of these restrictions is that water should be held in treated rice fields for 24 hours before release into drainage ditches (Aventis, 2000), a practice that is not always followed. It is also believed that less fipronil is transported off of the fields when ICON® treated rice is drill seeded than when it is water seeded. Since water seeding is primarily done to control red rice, advances made in red rice control could decrease water seeding and therefore reduce fipronil runoff. Additional cultural practices, such as delayed flooding and early planting, can also be used to decrease rice water weevil infestation and damage, thereby reducing the need to apply fipronil. Delaying flooding until rice plants have four to five leaves reduces rice susceptibility to yield loss from rice water weevils, while planting early in the growing season will allow producers to avoid exposing young, more susceptible rice to high populations of rice water weevils (Stout et al., 2002).

It is also of interest to note that the use of ICON® has been decreasing in Louisiana. Approximately 123,222 acres were planted in Louisiana with ICON treated seed in 2000, but only 36,621 acres were planted with ICON® treated seed in 2002.

APPENDIX A - BEST MANAGEMENT PRACTICES

<u>CROPLAND BEST MANAGEMENT PRACTICES (1) - Organic Matter & Bacteria Concerns in Surface Water</u>

PROBLEM: Animal waste and crop debris is the major organic pollutant resulting from agricultural activities. They place an oxygen demand on receiving waters during decomposition, which can result in stress or the death of fish and other aquatic species. Certain bacteria can cause disease in humans such as infectious hepatitis, typhoid fever, dysentery, and other forms of diarrhea.

PROCESSES: Movement of organic waste, bacteria, and organic matter in soil from the site and excess irrigation water.

CAUSES: Over-application of waste or irrigation water, application of waste on unsuitable sites, improper timing of waste or irrigation application, and storm runoff.

Favorable BMPs (2)	**Effectiveness of Favorable BMPs for: Oxy. Demand/Bacteria**		**Crops(3)**	**Practices Which May Be Unfavorable(4)**
Waste management	high	high	1-6	Land clearing
Waste utilization	high	high	1-6	Surface drainage(6)
Struct. water cont.	high	low	1-6	Subsurface drain(6)
Field border	med	medium		1,2,5,6(7)
Filter strips/buffers	med	medium		1,2,5,6(7)
Terrace	med	medium		1,2,5,6
Contour farming	med	medium		1,2,5,6
Stripcropping	med	medium		1,2,5,6
Water & sed. basin	med	low		1,2,5,6
Sediment basin med	low			1,2,5,6
Diversion	low	medium		1,2,5,6
Water mgt.(5) low	low		1-6	
Irrig. system (5) low	low		1-6	
Water table (8)	low	low	1-6	
Chiseling/subsoiling	low	low	1-6	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) 1 = cotton, 2 = soybeans, 3 = sugarcane, 4 = rice, 5 = corn, 6 = truck crops.
(4) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(5) Irrigated fields.
(6) Where water table control or regulating water in drainage systems is not applied.
(7) Fields not artificially drained.
(8) Where drainage practices already exist.

CROPLAND BEST MANAGEMENT PRACTICES(1) - Nutrient Concerns in Ground Water

PROBLEM: Soluble nutrients, mainly nitrogen, can reach ground water by percolation or through fractures, sinkholes, and solution channels. This process can cause significant problems in areas where high rates of nitrogen fertilization are used, soils are highly permeable, there is wide scale use of irrigation, and/or ground water levels are near the surface. High nitrate levels in drinking water can be hazardous to warm-blooded animals under conditions that are favorable to reduction to nitrite.

PROCESSES: Leaching of nitrogen below the root zone and water percolation below the root zone.

CAUSES: Nitrogen in excess of plant needs in the root zone, excess irrigation water application beyond the root zone capacity, faulty well or pump hardware, and improperly constructed wells.

Favorable BMPs(2)	Effectiveness of Favorable BMPs	Crops(3)	Practices Which May Be Unfavorable(4)
Nutrient manage	high	1-6	
Waste utilization	high	1-6	Vertical drains
Crop residue use	medium	1-6	
Conservation tillage	medium	1-6	
Cons. crop. seq.	medium	1-6	Chiseling & subsoil.
Cover & green manure crop	medium	1-6	Water & s. c. basin
Water table cont.	medium	1-6	Irr. canal/lat(5)(6)
Surface drainage	medium	1-6	Irr. fld ditch(5)(6)
Subsurface drainage	medium	1-6	
Water mgt.(5)	medium	1-6	
Water convey.(5)	medium	1-6	
Irrig. system (5)	medium	1-6	
Prec. land form.(5)	medium	1-6	
Grasses & legumes	low	1-6	
Struct. water cont.	low	1-6	
Water in dr. sys.	low	1-6	
Well(5)	low	1-6	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) 1 = cotton, 2 = soybeans, 3 = sugarcane, 4 = rice, 5 = corn, 6 = truck crops.
(4) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(5) Irrigated fields.
(6) Where canal, lateral, or field ditch conveys drainage or tailwater or where fertilizer is added to the irrigation supply.

CROPLAND BEST MANAGEMENT PRACTICES(1) - Organic Matter & Bacteria in Ground Water

PROBLEM: Animal waste and crop debris is the major organic pollutant resulting from agricultural activities. Of these, bacteria are the major pollutant concern in ground water. Certain bacteria can cause disease in humans such as infectious hepatitis, typhoid fever, dysentery, and other forms of diarrhea.

PROCESSES: Enters aquifer through fractures, sinkholes, and solution channels and enters through macropores.

CAUSES: Over-application of waste, application of waste on unsuitable sites, excess irrigation water application, and improper timing of waste application and irrigation water.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs**	**Crops(3)**	**Practices Which May Be Unfavorable(4)**
Waste utilization	high	1-6	Vertical drains
Nutrient manage.	medium	1-6	
Water mgt.(5)	medium	1-6	
Irrig. system(5)	medium	1-6	
Conservation tillage	low	1-6	
Cons. crop. seq.	low	1-6	
Filter strip/buffers	low	1-6	
Cover & green manure crop	low	1-6	
Well	low	1-6	
Crop residue use	low	1-6	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) 1 = cotton, 2 = soybeans, 3 = sugarcane, 4 = rice, 5 = corn, 6 = truck crops.
(4) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(5) Irrigated fields.

CROPLAND BEST MANAGEMENT PRACTICES(1) - Minerals or Salinity Concerns in Ground Water

PROBLEM: Excessive concentrations of salts/minerals can render ground water unfit for human and animal consumption. It can reduce or restrict the water's value for industrial and municipal use and irrigation. The toxic effect of certain chemicals can be enhanced in saline waters. The U. S. Public Health Service has established the maximum allowable concentrations of chlorides and sulfates in water for human consumption at 250 mg/l each. Excessive salt intake can produce minor to serious effects.

PROCESSES: Natural processes and leaching of minerals or salt concentrations.

CAUSES: Naturally occurring, excess water moving downward from human activity of concentrating water or changing evapotranspiration, and irrigation water which contains high concentrations of dissolved solids.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs**	**Crops(3)**	**Practices Which May Be Unfavorable(4)**
Soil salinity management	high	1-6	
Irrigation water mgt.(5)	high	1-6	Vertical drain
Subsurface drain	medium	1-6	Chiseling & subsoil.
Irrig. water convey.(5)	medium	1-6	Water & s. c. basin
Approp. irrig. system(5)	medium	1-6	Irr. fld ditch(5)(6)
Waste utilization	low	1-6	Irr. canal/lat(5)(6)
Cons. crop. sequence	low	1-6	
Toxic salt reduction	low	1-6	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) 1 = cotton, 2 = soybeans, 3 = sugarcane, 4 = rice, 5 = corn, 6 = truck crops.
(4) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(5) Irrigated fields.
(6) Where canal, lateral, or field ditch conveys drainage or tailwater, or where fertilizer is added to the irrigation supply.

CROPLAND BEST MANAGEMENT PRACTICES(1) - Pesticide Concerns in Ground Water

PROBLEM: Pesticides by their nature are toxic substances. Soluble pesticides can reach ground water through percolation, fractures, sinkholes and solution channels where some can persist for long periods of time rendering the ground water unsafe for drinking and/or causing expensive cleanup. Pesticide leaching is more critical in areas where high amounts are used, soils are highly permeable, there is wide scale use of irrigation, and/or ground water levels are near the surface.

PROCESSES: Leaching of pesticides below the root zone and water percolating below the root zone.

CAUSES: Excess pesticide applied, leachable pesticides, persistent pesticides, excess irrigation water, improper pesticide or irrigation application or timing, faulty well or pump hardware, improper mixing and handling of pesticides and pesticide containers, and improperly constructed wells.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs**	**Crops(3)**	**Practices Which May Be Unfavorable(4)**
Pest management	high	1-6	
Irrigation water mgt.(5)	medium	1-6	
Cons. crop. sequence	medium	1-6	Chiseling & subsoil.
Cover & green manure crop	medium	1-6	Water & s. c. basin
Precision land forming(5)	medium	1-6	Mulching
Water table control	medium	1-6	Vertical drain
Surface drainage	medium	1-6	
Subsurface drain	medium	1-6	
Reg. water in dr. sys.	medium	1-6	Irr. fld ditch(5)(6)
Irrig. water convey.(5)	low	1-6	Irr. canal/lat(5)(6)
Approp. irrig. system(5)	low	1-6	
Well	low	1-6	
Struct. for water control	low	1-6	
Grasses & legumes in rot.	low	1-6	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) 1 = cotton, 2 = soybeans, 3 = sugarcane, 4 = rice, 5 = corn, 6 = truck crops.
(4) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(5) Irrigated fields.
(6) Where canal, lateral, or field ditch conveys drainage or tailwater or where pesticide is added to the irrigation supply.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Sediment Concerns in Surface Water

PROBLEM: Sediment in a water body can smother benthic organisms, interfere with photosynthesis by reducing light penetration, and may fill in waterways, hindering navigation and increasing flooding. Sediment particles often carry nutrients and pesticides and other organic compounds into water bodies. Sediments can be resuspended in a water column and act as an uncontrolled source of pollution.

PROCESS: Movement of sediment from site.

CAUSES: Concentration of livestock in or near watercourses leading to instability and overuse of vegetation.

Favorable BMPs(2)	Effectiveness of Favorable BMPs	Practices Which May Be Unfavorable(3)
Pasture & hayland planting	high	Land clearing
Irrigation water management(4)	high	
Critical area planting	high	
Fencing(5)	high	
Fencing(6)	medium	
Prescribed Grazing	medium	
Mechanical Forage Harvest	medium	
Irrigation water conveyance(4)	medium	
Appropriate irrigation system(4)	medium	
Filter strip/buffer	medium	
Pond(6)	medium	
Well(6)	medium	
Spring development(6)	medium	
Trough or tank(6)	medium	
Pipeline(6)	medium	
Brush management	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Irrigated fields.
(5) To exclude livestock from streams.
(6) To distribute grazing.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Nutrient Concerns in Surface Water

PROBLEM: Excess nitrogen and phosphorus in a water body causes excessive plant and algae growth, an imbalance of natural nutrient cycles, and a decline in the number of desirable fish species. High nitrate levels can be hazardous to warm-blooded animals under conditions that are favorable to reduction to nitrite.

PROCESSES: Runoff of soluble nitrogen and phosphorus in water and movement of nitrogen and phosphorus combined with soil and organic matter from site.

CAUSES: Excess surface applied nitrogen and phosphorus, runoff water and interflow, erosion of soil and organic waste, cattle congregating in or near streams, and excess irrigation water application beyond root zone.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs for: Soluble N./Adsorbed N.**		**Practices Which May Be Unfavorable(3)**
Nutrient management	high	high	Surface drainage(4)
Waste utilization	high	high	Subsurface drain(4)
Irrigation water management(5)	high	high	
Pasture & hayland planting	high	high	
Fencing(6)	high	high	
Pond	high	high	
Buffers	low	high	
Fencing(7)	medium	medium	
Well(7)	medium	medium	
Trough or tank(7)	medium	medium	
Pipeline(7)	medium	medium	
Prescribed Grazing	medium	medium	
Mechanical forage harvest	low	medium	
Spring development	low	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Where water table control or regulating water in drainage systems is not applied.
(5) Irrigated fields.
(6) To exclude livestock from streams.
(7) To distribute grazing.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Pesticide Concerns in Surface Water

PROBLEM: Pesticides by their nature are toxic substances. Many are highly toxic to fish, other aquatic fauna, and warm-blooded animals. Some persist in the aquatic environment for long periods of time so that even at very low concentrations, they are a serious environmental concern in runoff water.

PROCESSES: Runoff of soluble pesticides in water and movement of pesticides combined with soil and organic matter from site.

CAUSES: Excess pesticide applied, pesticides with affinity for soil and organic matter, persistent pesticides, runoff water and interflow, improper pesticide application and/or timing, improper mixing and handling of pesticides and pesticide containers, and excess irrigation water application beyond root zone.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs for: Soluble P./Adsorbed P.**		**Practices Which May Be Unfavorable(3)**
Pasture & hayland planting	high	high	Subsurface drain(4)
Irrigation water management(5)	high	high	Surface drainage(4)
Prescribed grazing	low	medium	
Forage harvest management	low	medium	
Filter strips/buffers	medium	medium	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Where water table control or regulating water in drainage systems is not applied.
(5) Irrigated fields.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Organic Matter & Bacteria Concerns in Surface Water

PROBLEM: Animal waste and plant debris is the major organic pollutant from pastureland. They place an oxygen demand on receiving waters during decomposition, which can result in stress or the death of fish and other aquatic species. Certain bacteria can cause disease in humans such as infectious hepatitis, typhoid fever, dysentery, and other forms of diarrhea.

PROCESS: Movement of organic waste, bacteria, and organic matter in soil and water from the site.

CAUSES: Over application of waste, application of waste on unsuitable sites, improper timing of waste application, storm runoff, and concentration of livestock in or near watercourses.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs for: Oxy. Demand**	**Bacteria**	**Practices Which May Be Unfavorable(3)**
Waste utilization	high	high	Surface drainage(4)
Pond	high	high	Subsurface drain(4)
Nutrient management	high	high	
Fencing(5)	high	high	
Fencing(6)	medium	medium	
Filter strip/buffers	medium	medium	
Prescribed grazing	medium	medium	
Mechanical forage harvest	medium	medium	
Pasture and hayland planning	medium	medium	
Well(6)	medium	medium	
Trough or tank(6)	medium	medium	
Pipeline(6)	medium	medium	
Spring development(6)	low	low	
Irrigation water management(7)	low	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Where water table control or regulating water in drainage systems is not applied.
(5) To exclude livestock from streams.
(6) To distribute grazing.
(7) Irrigated fields.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Minerals or Salinity Concerns in Surface Water

PROBLEM: Excessive concentrations of salts/minerals in surface waters can render the waters unfit for human and animal consumption and impair the growth of plants. It can also reduce or restrict the water's value for industrial use, irrigation and for propagation of fish and wildlife. The toxic effect of certain chemicals can be enhanced in saline waters. Excessive salts can adversely alter the permeability of soils. The U.S. Public Health Service has established the maximum allowable concentrations of chlorides and sulfates in water for human consumption at 250 mg/l each. Excessive salt intake can produce minor to serious effects.

PROCESSES: Natural processes, movement of organic waste, sheet flow from surface runoff and interflow from ground water as influenced by human activities.

CAUSES: High content of minerals and salt concentration in soil and underlying geology, over application of waste with high salinity content, movement of minerals and salinity in soil from the site by precipitation runoff and interflow (saline seeps), high content of minerals and salt concentration in irrigation water, and excess irrigation water.

Favorable BMPs(2)	**Effectiveness of Favorable BMPs**	**Practices Which May Be Unfavorable(3)**
Irrigation water management(4)	high	Land clearing
Nutrient management	high	Subsurface drain(5)
Irrigation water conveyance(4)	medium	Surface drainage(5)
Appropriate irrigation system(4)	medium	
Forage harvest management	medium	
Prescribed grazing	medium	
Waste utilization	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Irrigated fields.
(5) Where water table control or regulating water in drainage systems is not applied.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Minerals or Salinity Concerns in Ground Water

PROBLEM: Excessive concentrations of salts/minerals can render ground water unfit for human and animal consumption. It can reduce or restrict the water's value for industrial and municipal use and irrigation. The toxic effect of certain chemicals can be enhanced in saline waters, and the saturation levels of dissolved oxygen decreases with increasing salinity. The U. S. Public Health Service has established the maximum allowable concentrations of chlorides and sulfates in water for human consumption at 250 mg/l each. Excessive salt intake can produce minor to serious effects.

PROCESSES: Natural processes and leaching of minerals or salt concentrations.

CAUSES: Naturally occurring, excess water moving downward from human activity of concentrating water or changing evapotranspiration, and irrigation water contains high concentration of dissolved solids.

Favorable BMPs(2)	Effectiveness of Favorable BMPs	Practices Which May Be Unfavorable(3)
Irrigation water management(4)	high	Irrigation field ditch(4)
Surface drainage	medium	Irrigation canal/lateral(4)
Subsurface drain	medium	Soil salinity management
Water table control	medium	Toxic salt reduction
Regulating water in dr. systems	medium	
Irrigation conveyance(4)	medium	
Appropriate irrigation system(4)	medium	
Nutrient management	medium	
Waste utilization	medium	
Prescribed grazing	low	
Mechanical forage harvest	low	
Pasture/hayland planting	low	
Fencing	low	
Pond	low	
Trough or tank	low	
Spring development	low	
Pipeline	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Irrigated fields.

<u>PASTURELAND BEST MANAGEMENT PRACTICES(1) - Organic Matter & Bacteria Concerns in Ground Water</u>

PROBLEM: Animal waste and plant debris are the major organic pollutants resulting from agricultural activities. Of these, bacteria are the major pollutant concern in ground water. Certain bacteria can cause disease in humans such as infectious hepatitis, typhoid fever, dysentery, and other forms of diarrhea.

PROCESSES: Enters aquifers through macropores, fractures, sinkholes, and solution channels.

CAUSES: Over application of waste, application of waste on unsuitable sites, and concentration of livestock in sinkholes and fractured limestone areas.

Favorable BMPs(2)	Effectiveness of Favorable BMPs	Practices Which May Be Unfavorable(3)
Waste utilization	high	
Fencing(4)	high	
Nutrient management	medium	
Fencing(5)	medium	
Irrigation water management(6)	medium	
Prescribed grazing	medium	
Water & sediment control basin	medium	
Trough or tank(5)	medium	
Pond(5)	medium	
Well(5)	medium	
Pipeline(5)	medium	
Filter strip	low	
Spring development(5)	low	
Mechanical forage harvest	low	
Grassed waterway	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) To exclude livestock from sinkholes and fractured areas where feasible.
(5) To distribute grazing.
(6) Irrigated fields.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Nutrient Concerns in Ground Water

PROBLEM: Soluble nutrients, mainly nitrogen, can reach ground water by percolation through fractures, sinkholes, and solution channels. This process can cause significant problems in areas where high rates of nitrogen fertilization are used, soils are highly permeable, there is wide scale use of irrigation, and/or ground water levels are near the surface. High nitrate levels in drinking water can be hazardous to warm-blooded animals under conditions that are favorable to reduction to nitrite.

PROCESS: Leaching of nitrogen.

CAUSES: Applied nitrogen in excess of plant needs in the root zone, cattle concentrating in one area for water, and excess irrigation water application beyond root zone capacity,

Favorable BMPs(2)	**Effectiveness of Favorable BMPs**	**Practices Which May Be Unfavorable(3)**
Nutrient management	high	Irrig. field ditch(4)(5)
Waste utilization	high	Irrig. canal & lat.(4)(5)
Pasture & hayland planting	high	
Forage harvest management	high	
Irrigation water management(4)	medium	
Irrigation conveyance(4)	medium	
Appropriate irrigation system(4)	medium	
Fencing(6)	medium	
Trough or tank(6)	medium	
Pipeline(6)	medium	
Surface drainage	medium	
Subsurface drain	medium	
Water table control	medium	
Reg. water in drainage systems	medium	
Prescribed grazing	low	
Spring development	low	
Pond	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Irrigated fields.
(5) Where ditch, canal, or lateral conveys drainage or tailwater, or where fertilizer is added to the irrigation supply.
(6) To distribute grazing.

PASTURELAND BEST MANAGEMENT PRACTICES(1) - Pesticide Concerns in Ground Water

PROBLEM: Pesticides by their nature are toxic substances. Soluble pesticides can reach ground water through percolation, fractures, sinkholes, and solution channels where some can persist for long periods of time rendering the ground water unsafe for drinking and/or causing expensive cleanup. Pesticide leaching is more critical in areas where high amounts are used, soils are highly permeable, there is wide scale use of irrigation, and/or ground water levels are near the surface.

PROCESS: Leaching of pesticides.

CAUSES: Excess pesticide applied, leachable pesticides, persistent pesticides, improper pesticide application or timing, improper mixing and handling of pesticides and pesticide containers, and excess irrigation water application beyond root zone capacity.

Favorable BMPs(2)	Effectiveness of Favorable BMPs	Practices Which May Be Unfavorable(3)
Irrigation water management(4)	medium	Irrig. canal & lat.(4)(5)
Surface drainage	medium	Irrig. field ditch(4)(5)
Subsurface drain	medium	
Water table control	medium	
Prescribed grazing	low	
Pasture & hayland planting	low	
Forage harvest management	low	
Irrigation conveyance(4)	low	
Appropriate irrigation system(4)	low	

(1) There are many other practices not listed in this table which may be considered for installation for a specific purpose or as a part of a total resource management system which may increase or decrease loading or have little or no effects on water quality on a site-specific basis. An on-site analysis should be a consideration in evaluating the effect of a practice not listed.
(2) This list is not ranked in an order, which would indicate preference in installation.
(3) An on-site evaluation should be conducted to determine if conditions exist which would result in unfavorable effects if the practice was installed.
(4) Irrigated fields.
(5) Where ditch, canal, or lateral conveys drainage or tailwater, or where pesticide is added to the irrigation supply.

APPENDIX B: BMP IMPLEMENTATION - RELATED PROJECTS

THE MASTER FARMER PROGRAM

LSU AgCenter is promoting the Master Farmer Program to help farmers address environmental stewardship through voluntary, effective, and economically achievable BMPs. The program is being implemented through a multi-agency/organization partnership including the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the Louisiana Cooperative Extension Service (LCES), USDA-Agriculture Research Service (ARS), LDEQ, and agricultural producers.

The Master Farmer Program has three components: environmental stewardship, agricultural production, and farm management. The environmental stewardship component has three phases. Phase I focuses on the environmental education and crop-specific BMPs and their implementation. Phase II of the environmental component includes in-the-field viewing of implemented BMPs on "Model Farms." Farmers are able to see farms that document BMP effectiveness in reducing sediment runoff. Phase III involves the development and implementation of farm-specific, comprehensive conservation plans by the participants. A member must participate in all three phases in order to gain program status.

This program can help to initiate and distribute the use of BMPs throughout the Mermentau basin. The members will set an example for the rest of the agricultural community. They will work closely with scientists and other Master Farmers to identify potential problem areas in the watershed. They will receive information on new and innovative ways to reduce soil and nutrient loss from their fields. They will be kept abreast of the water quality monitoring occurring in the watershed and alerted of any degradation or improvements. The Master Farmer Program will allow regulators to observe the acceptance of BMPs throughout the watershed and they will help LDEQ observers track the implementation of soil management plans.

The solutions to controlling runoff will require the joint efforts of agriculture producers, landowners, government, private citizens and private organizations working together. The Louisiana Cooperative Extension Service (LCES) and Louisiana State University (LSU) AgCenter conducted a commodity-specific BMP review. These reviews were conducted through a multi-agency/organization partnership made up of research and extension scientists, the Louisiana Farm Bureau (LFBF), the Natural Resources Conservation Service (NRCS), the LDEQ, USDA-Agriculture Research Service (ARS), and agriculture producers.

ACHIEVING GOALS: BMP IMPLEMENTATION AND COST SHARE

Cost share funding for BMPs is a key element in a successful Implementation Plan. A number of Federal and State funding sources exist for BMP implementation, riparian zones, and land conservation. The LDEQ provides the USEPA §319(h) funding to assist in implementation of BMPs to address water quality problems on reaches listed on the §303(d) list of impaired waters. USEPA §319(h) funds were utilized to sponsor the cost sharing and monitoring projects discussed above. These monies are available to all private, for profit and nonprofit organizations that are authenticated legal entities, or governmental jurisdictions including: cities, counties, tribal entities, Federal agencies, or agencies of the State. Proposals are submitted by applicants through a Request for Proposal (RFP) process and require a non-federal match of 40% of the total project cost consisting of funds and/or in-kind services. Further information on funding from the Clean Water Act §319 (h) can be found at the LDEQ web site at: www.deq.la.gov.

COST SHARE: FUNDING CURRENTLY ACTIVE

The Office of Soil and Water Conservation at the Louisiana Office of Agriculture and Forestry is currently the agency that implements the incremental funds associated with Louisiana's Nonpoint Source Management Plan. They apply directly to USEPA Region 6 for Section 319 funds and utilized them to assist landowners and farmers implement best management practices (BMPs) within watersheds where total maximum daily loads (TMDLs) have been completed and watershed plans have been written. LDAF has been working in the Bayou Lacassine and Bayou Chene watersheds and continues to offer cost-share funds to farmers who want to participate in BMP programs to reduce nonpoint source pollutants and improve water quality. These tables illustrate the extent of this work that has been done by USDA, LDAF and through the Master Farmer Program within these two watersheds.

Bayou Lacassine 050601

BMP's	EQIP Ac/No/Ft	Mermentau 319 Ac/No/Ft	Master Farmer Ac/No/Ft	Totals Ac/No/Ft
328 - Conservation Crop Rotation (Ac)	2668.3	8207.1	115.1	**10990.5**
329B - Residue Management No-Till (Ac)	0	399.9	0	**399.9**
344 - Residue Management Seasonal (Ac)	1289.8	7005.1	115.1	**8410**
351 - Well Decommissioning (No)	3	0	0	**3**
382 - Fence (Ft)	10188	0	0	**10188**
410 - Grade Stabilization Structures (No)	75	49	0	**124**
430EE - Irrigation Water Conveyance (Ft)	32039	0	0	**32039**
449 - Irrigation Water Management (Ac)	2782.1	5451.3	115.1	**8348.5**
DS - Dry Seeding (Ac)	0	1581.8	0	**1581.8**
464 - Irrigation Land Leveling (Ac)	3891.7	2252.1	0	**6143.8**
512 - Pasture/Hayland Planting (Ac)	165.6	0	0	**165.6**
516 - Pipeline (Ft)	23035	0	0	**23035**
528A - Prescribed Grazing (Ac)	260.8	578.7	0	**839.5**
561 - Heavy Use Area for Protection (No)	18	2	0	**20**
590 - Nutrient Management (Ac)	600	6315	115.1	**7030.1**
595 - Pest Management (Ac)	0	6315	115.1	**6430.1**
614 - Watering Facility (No)	17	0	0	**17**
642 - Well (No)	3	0	0	**3**
645 - Upland Wildlife Management (Ac)	0	27.1	0	**27.1**
646 - Shallow Water Mgmt for Wildlife (Ac)	40.6	1558.5	0	**1599.1**
Total Acres	**11,698.9**	**39693.5**	**575.5**	**51,967.9**
Total Feet	**65,262**			**65,262**
Total Number (No)	**116**	**51**		**167**

Bayou Chene 050603

BMP's	EQIP Ac/No/Ft	Mermentau 319 Ac/No/Ft	Totals Ac/No/Ft
328 - Conservation Crop Rotation (Ac)	0	10803.1	**10803.1**
344 - Residue Management Seasonal (Ac)	406.5	8975.1	**9381.6**
351 - Well Decommissioning (No)	9	0	**9**
382 - Fence (Ft)	24539	0	**24539**
410 - Grade Stabilization Structures (No)	82	38	**120**
430EE - Irrigation Water Conveyance (Ft)	46583	0	**46583**
449 - Irrigation Water Management (Ac)	1203.7	7509.1	**8712.8**
DS - Dry Seeding (Ac)	0	1938.2	**1938.2**
464 - Irrigation Land Leveling (Ac)	3300.2	3828	**7128.2**
512 - Pasture/Hayland Planting (Ac)	39.8	0	**39.8**
516 - Pipeline (Ft)	9623	0	**9623**
528A - Prescribed Grazing (Ac)	621.1	47.8	**668.9**
533 - Pumping Plant (No)	1	0	**1**
561 - Heavy Use Area for Protection (No)	5	4	**9**
590 - Nutrient Management (Ac)	28.2	12209.5	**12237.7**
595 - Pest Management (Ac)	0	12209.5	**12209.5**
614 - Watering Facility (No)	0	0	**0**
642 - Well (No)	2	0	**2**
645 - Upland Wildlife Management (Ac)	5	347.2	**352.2**
646 - Shallow Water Mgmt for Wildlife (Ac)	0	3417.2	**3417.2**
Total Acres	**5604.5**	**61,284.7**	**66,889.2**
Total Feet	**80,745**		**80,745**
Total Number	**99**	**42**	**141**

Other Federal and State funds

The U.S. Department of Agriculture (USDA) offers landowners financial, technical, and educational assistance to implement conservation practices on privately owned land to reduce soil erosion, improve water quality, and enhance crop land, forest land, wetlands, grazing lands and wildlife habitat. One of these programs is the Conservation Reserve Program (CRP). It is designed to encourage farmers to convert highly erosive cropland to vegetative cover, such as native grasses, wildlife plantings, trees, filter strips, or riparian buffers. Farmers receive annual rental payment for the term of the multi-year contract. The Conservation Reserve Enhancement Program (CREP) combines the resources of the CRP program with that of the State government. This program focuses on NPS pollution and water and habitat restoration. The Environmental Quality Incentives Program (EQIP) is another source of funding available to the farmers for conservation practices. These are a few of the State and Federal funding sources available to agricultural landowners that will help with the cost of reducing NPS run-off from their fields.